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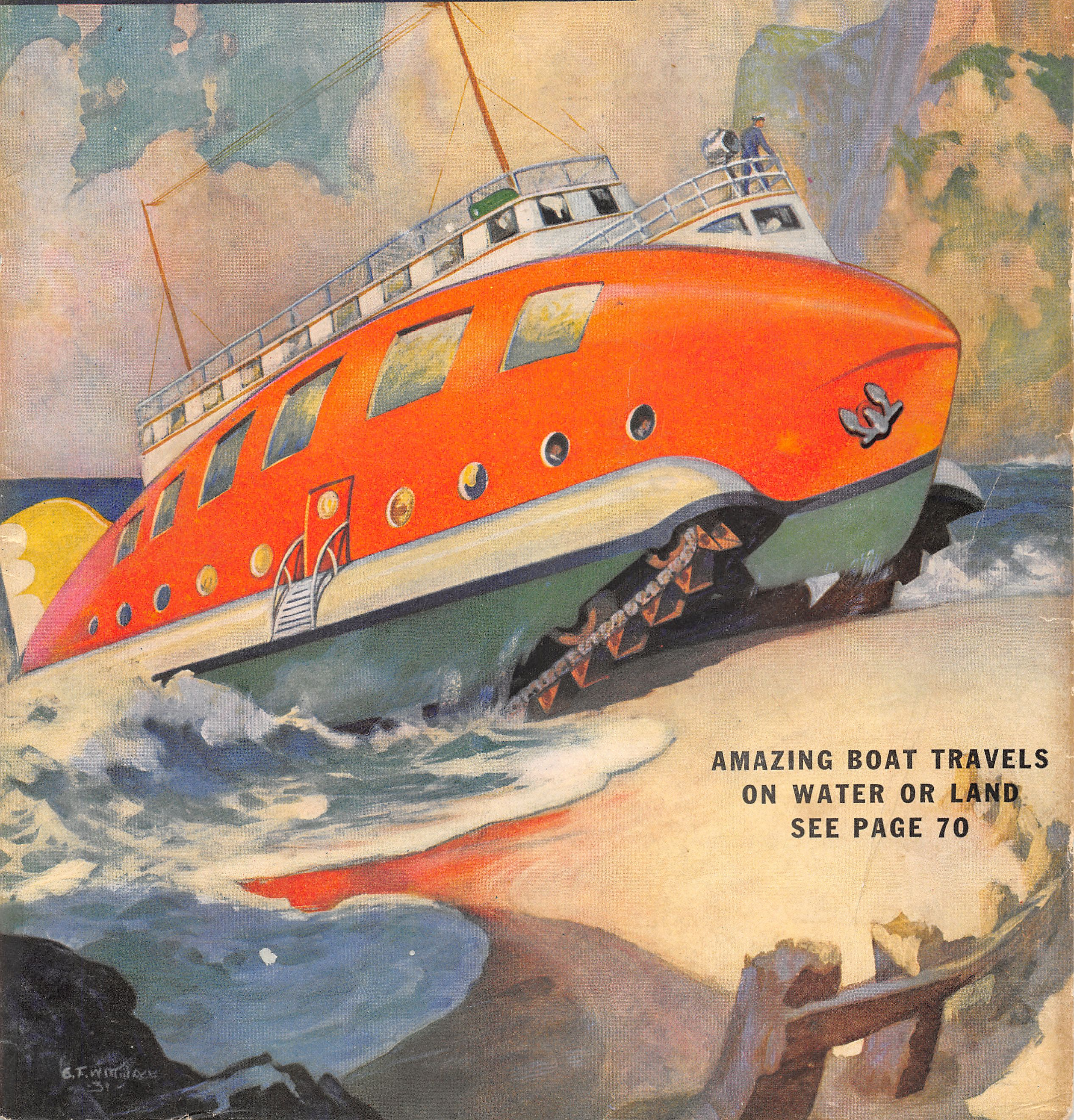
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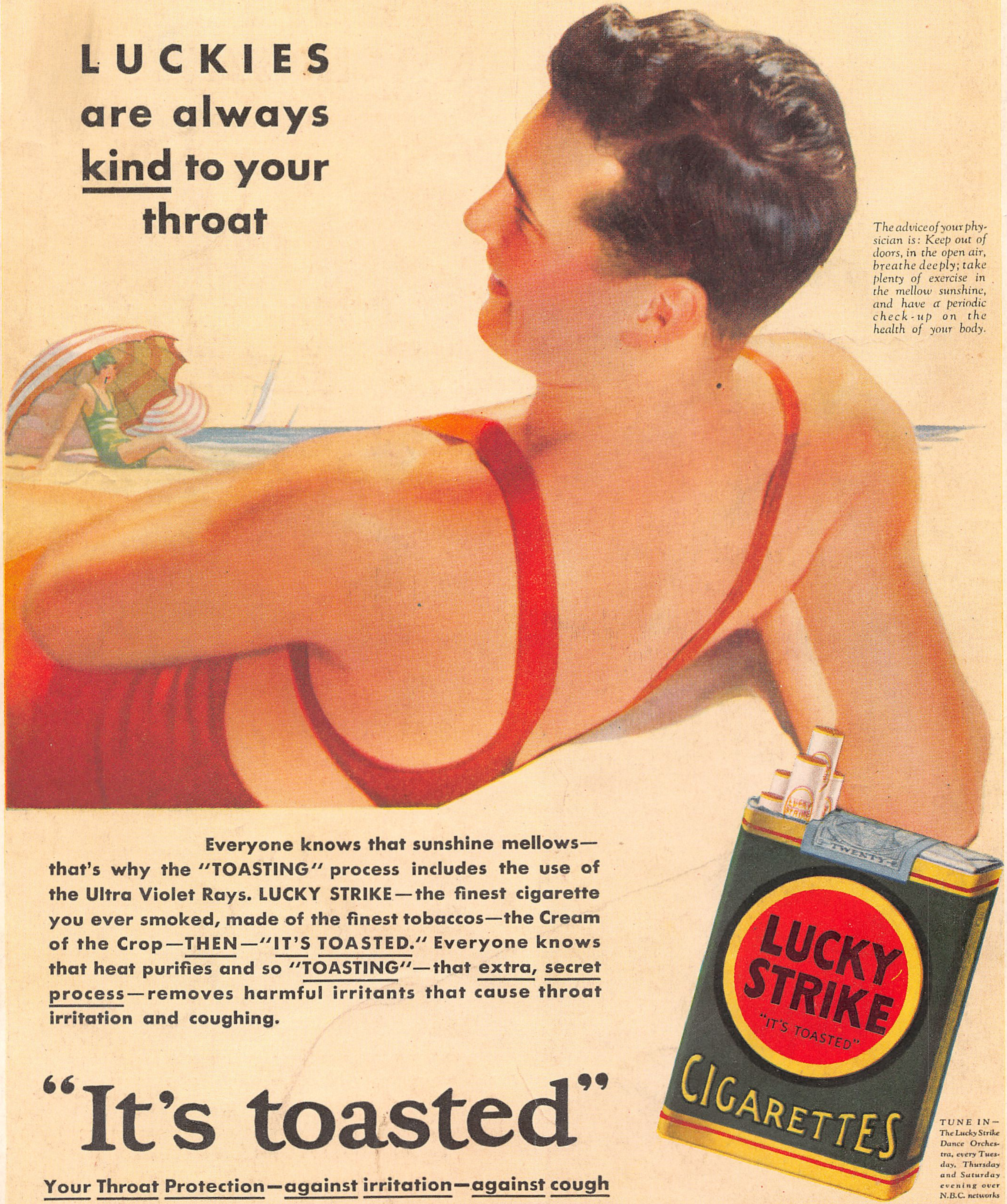

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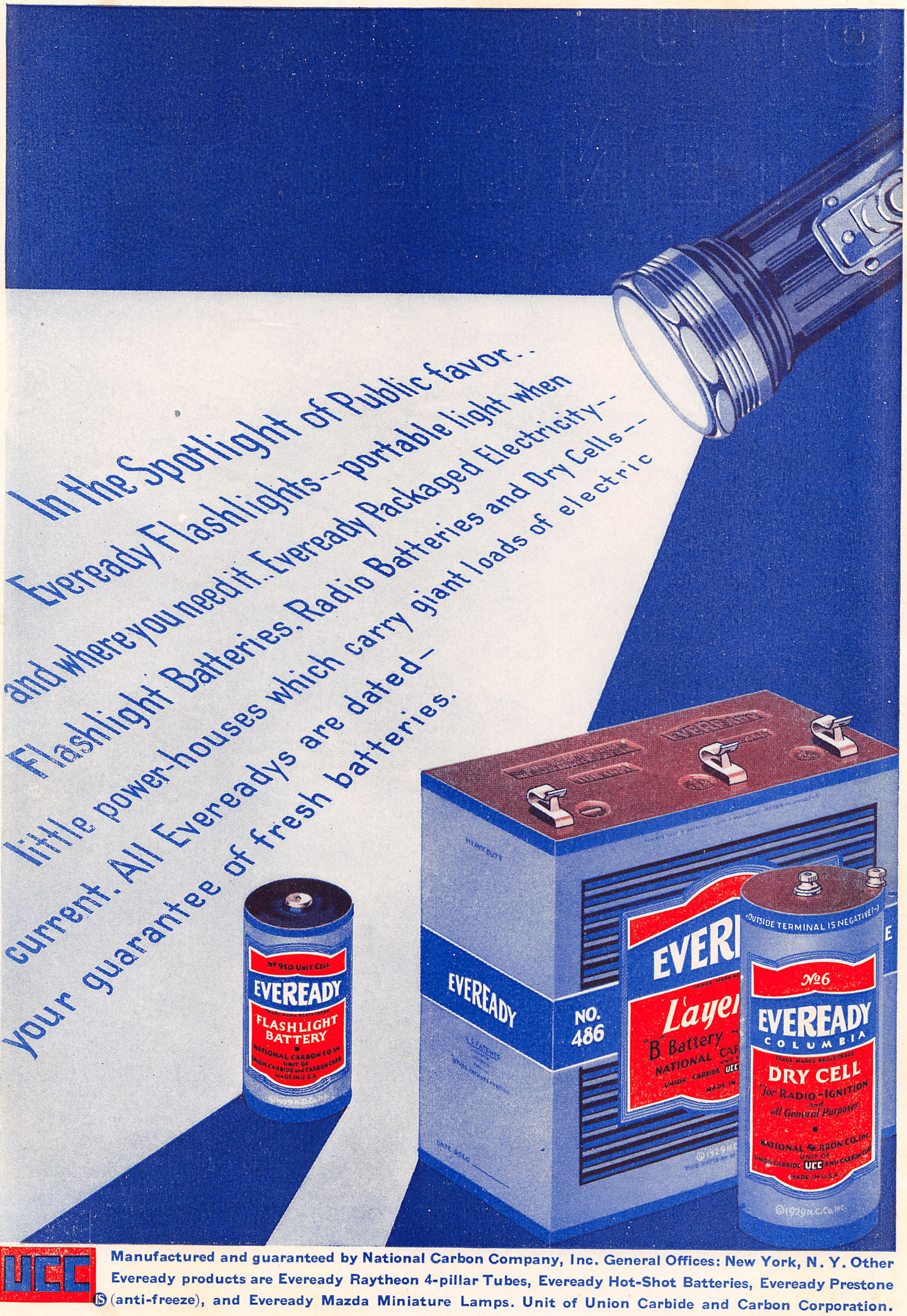
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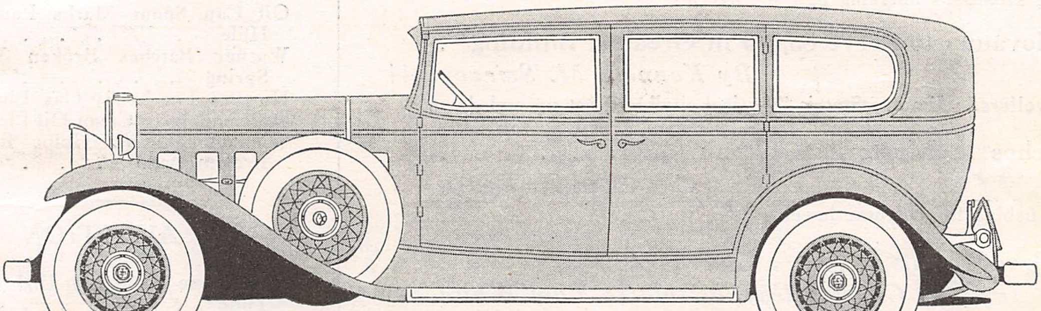

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The Popular Science Monthly
381 - 4th Ave. New York

Why Some Investment Trusts Are Safer Than Others

By LEON MEADOW, *Financial Editor*

IT WAS just a few minutes after noon and the restaurant was very crowded. Charlie Parker, looking around for an empty table, spied a familiar face over in a corner of the room. He started down an aisle, threading his way between the closely spaced tables.

"Well, if it isn't Bob Travers! Thought I recognized that face."

The man raised his eyes from the menu he was reading at the moment, and a look of surprise crossed his face. "As I live—old Charlie Parker. Sit down, boy . . . certainly is good to see you after all these years."

Parker sat down, and the two men, strangers since their school days, began to exchange the commonplaces usual to such meetings. In the course of their conversation Parker learned that Bob Travers was connected with an investment brokerage house. "That's interesting, Bob—perhaps you can clarify a few things for me. I've been doing a little investing lately, and it seems to me that every time the subject comes up, the question of investment trusts arises. I've heard so much for and against this type of security, that I really don't know what to believe. I've had pictures of huge profits painted for me—I've had the question of true investment as against comparative speculation put before me—and dozens of other debatable points about investment trusts raised continuously. But nothing seems to really explain their good and weak points for me. What I want to know primarily is how safe they are, and how I can tell which ones are safer than others."

Bob Travers laughed. "Books could be filled with the answers to those questions, and in one lunch hour I certainly couldn't do full justice to the subject. If you want, I can sketch very briefly what I've learned about that phase of investment trusts."

"I wish you would," his friend replied. "Every little bit helps."

Travers lit a cigarette and studied the glowing ash for a few minutes. "If, by safety," he began, "you mean the impossibility of loss—then the answer is 'no.' You can't buy an investment trust stock that will guarantee you absolute safety. But don't misinterpret that statement. Nothing in this world carries so absolute a guarantee that something else can't come along and make that guarantee worthless. For that matter, there's no guarantee that this world itself will still be here tomorrow. In other words, investment trusts, like everything else, must be judged on a comparative basis. All of these trusts have stocks among their holdings, and it is evident that the value of stocks is not fixed but fluctuates according to the earnings trend of the corporations which issue them, and according to general business and stock market movements as well. Since the shares of investment trusts are either wholly or partly based on such stocks, it is only natural that their market value should more or less follow the rise and fall of the stocks held by that trust.

"The degree of risk varies greatly, being dependent upon the character of the trust, its capital set-up and its holdings. Now take the so-called 'Fixed Trust' . . . .

"You mean" interrupted Charlie, "a trust which cannot change its holdings except under certain drastic conditions?"

"Yes. Fixed Trusts issue only one kind of stock and do not offer bonds or preferred stocks against the securities which they hold. Consequently the value of their shares fluctuates in the same proportion as the value of their stockholdings. For example, a fixed trust has a portfolio—or holdings—worth $1,000,000. It has nothing but its own common stock outstanding. Let's suppose that this consists of 100,000 shares, meaning that the value of each share is $10. Now, if the $1,000,000 worth of securities goes up 20% in market value—to $1,200,000, then the trust's stock also goes up 20%—to $12. a share. Or vice-versa, if the market value of the portfolio drops 20%, the value of your trust shares goes down accordingly to $8.

"The point I want to make here is that there is little chance of these trust shares becoming totally worthless unless the holdings of this trust are wiped out with an entire 100% loss, and in the case of intelligent, selected high-grade stockholdings, this is not only unlikely but almost impossible."

"Of course . . . I see that," Charlie broke in at this point, almost impatiently, "Now let's take the management type of investment trust, where the holdings are not fixed, but can be bought or sold entirely at the discretion of the management board. "Are these trusts just as safe or are they in another boat?"

"Some of them are, as you put it, 'in another boat,'" Bob replied, "because a great many trusts of the management type employ senior capital."

"What do you mean?" Parker asked.

"That simply means," Travers answered, "That they not only have common stock outstanding, but also preferred issues or bonds or sometimes both. Now, here you have something of a more speculative nature, something that can be very attractive if everything goes well. But in a declining market its value can shrink very rapidly and may be totally wiped out in extreme cases. Just let's assume that that kind of investment trust also owns $1,000,000 worth of securities. Against this it has issued $500,000 worth of its own bonds, $300,000 worth of its own preferred stock and the remaining $200,000—or 20% in common stock—20,000 shares of it valued at $10. a share.

"Now the holdings of this trust go up 20% in market value—making the securities worth $1,200,000. Deduct out of that $800,000 for the bonds and preferred stocks and there will be left $400,000 for the 20,000 shares of common stock, mak-

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WHY SOME INVESTMENT TRUSTS ARE SAFER THAN OTHERS

(Continued from page 4)

ing each share worth $20. In other words, a 20% rise in the market value of the trust's portfolio has raised the value of its common stock 100%. Likewise, a 20% drop in the market value of its holdings will cause a 100% loss on the common stock of the trust, since the $800,000 left by such a drop would be taken up by the outstanding amount on the bonds and preferred stocks."

"Just a minute, Bob. When you look at it that way, from the common stockholder's point of view it's just as if the trust had bought stocks on margin—or on money obtained from the bond and preferred stockholders."

"Exactly," Travers agreed. "And everybody knows that you can make money faster on margin speculation . . .

"And lose it much faster than if you bought outright," said Charlie Parker, finishing Bob's statement.

"Absolutely," continued Travers. "Now, there are some investment trusts of the management type which do not employ senior capital, and in this respect they are comparable with fixed trusts. The difference between the two from a safety standpoint is that the fixed trust cannot as a rule change its holdings, whereas the management trust can. In the latter, if the management's operations are successful, they can result in sizeable profits and prevent losses which the fixed trust—with its hands tied—has to accept. On the other hand, the management trust can also make investment errors and thus cause larger losses than the fixed trust would have to suffer.

"Before I forget, there's another point in connection with the use of senior capital that needs some further explanation. If the value of the shares of such a trust has already shrunk to, or near to, zero, they still command a market price of about two or three dollars per share."

"How is that?"

"It's due to the fact that there is still a demand for them by some investors who count on a market recovery to make them valuable again. Since the purchaser of such shares risks only a small amount of money, put up for each share, he knows definitely the limits of any probable loss—and at the same time, he stands to reap large profits, should a substantial recovery in the market value of the trust's portfolio take place. In all events it is speculative, and the wise investor should realize this."

Bob stopped at this point, and for a while Charlie made no attempt to carry on the discussion. Finally he said, "I know a great deal more about investment trusts than I did. Now tell me—how would you classify them as to safety?"

"From what I've said," Travers replied, "you can see how much depends on the particular circumstances of each trust. You can't therefore draw a sharp line and say, 'all these on this side are safe, and all those on the other side are not safe.' Generally speaking I'd classify them as follows:

First—Fixed Trusts holding high grade securities.
Second—Management Trusts carrying high grade securities, but not employing senior capital.
Third—Management Trusts holding high grade securities and using senior capital.
Fourth—all other trusts."

"Well," Charlie put in, "that should be definite enough for anyone. Now to get back to our original point about risk—how does this apply to these classifications?"

"It applies in this way—if a prospective investor is thinking about buying investment trust shares, and he doesn't want to allow even the slightest percentage of risk on his choice, or refuses to see such a possibility, then he is making a mistake. His money should stay in the savings bank. But if he is human to the point of accepting a small but fair degree of risk, then his choice should lie between the first three classifications—the fourth should not be considered at all. And always he should remember that the larger his risk, the larger his possible profits and *vice-versa.*"

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"The Provident Provider" is a booklet describing a new savings plan which provides a regular retirement income for a man and insurance protection for his family. A copy will be mailed on request by Provident Mutual Life Insurance Company, Philadelphia, Pennsylvania.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

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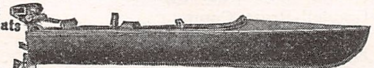

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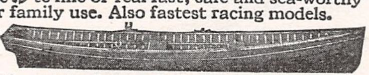

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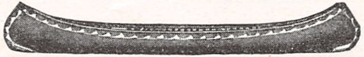

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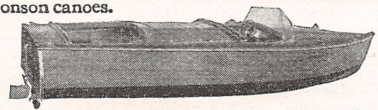

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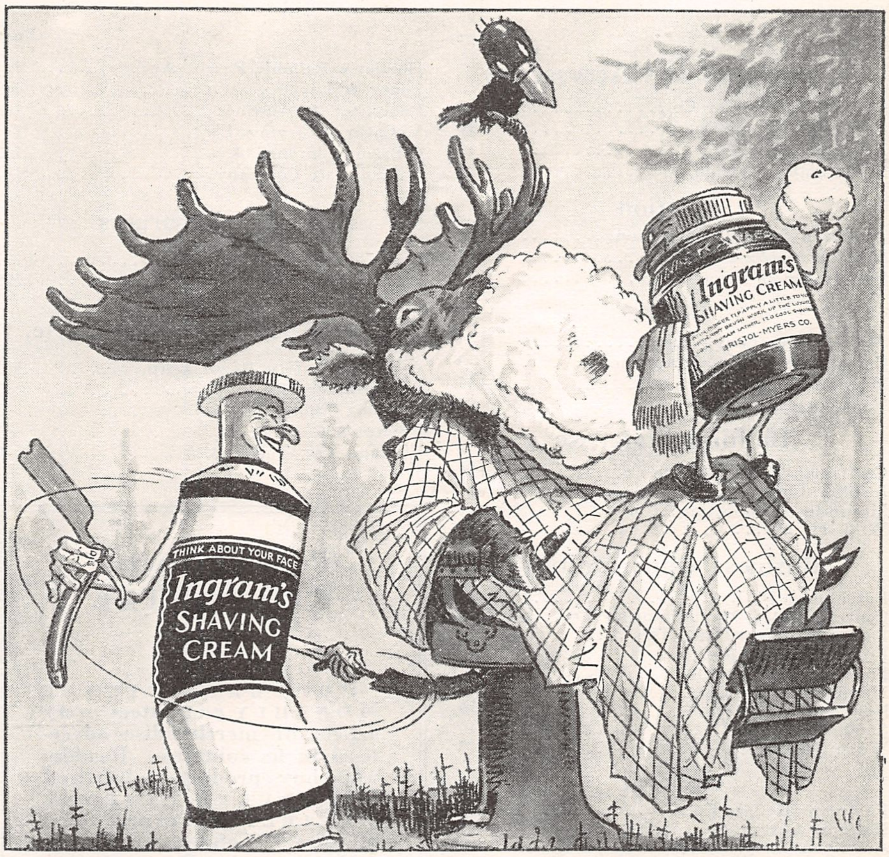

I'M A MOOSE and I don't mean a Senator from Pennsylvania. I live up here in Labrador. I thought I knew what COOL meant. But I was wrong!

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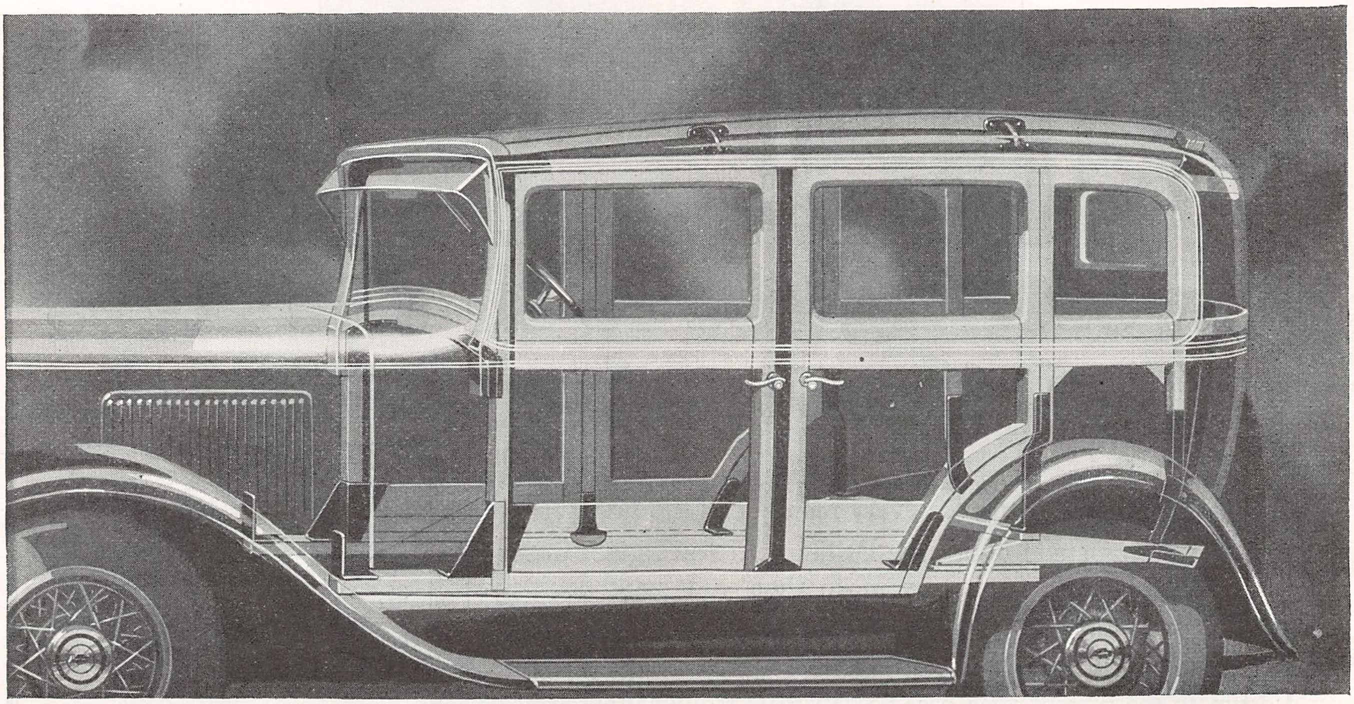
Chevrolet uses the Fisher composite body construction of wood and steel



As most technical men know, the use of wood and steel in combination is the basic structural principle of all expensive coachwork.

Fisher Body has always used this construction, because it is stronger, more durable and more resilient. In closed bodies for the low-priced Chevrolet Six, Fisher employs this principle, without compromise.

The framework of Chevrolet-Fisher bodies is made of selected, seasoned wood. Every joint is accurately fitted, carefully mortised, and screwed or bolted, in addition to being glued. All points where extra stress or strain is likely to take place are fortified with special steel braces. And a paste of linseed oil and white lead is laid between the wood and steel to prevent rust and preserve the wood.

Over this solid wood foundation, staunch steel panels are then secured so that the wood reinforces the steel and the steel reinforces the wood. These panels are made on costly steel-faced dies which give them a smooth, solid surface. Huge presses stamp them in large units, with mouldings and window reveals shaped to the proper contours in the metal itself, for the sake of strength and good appearance.

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This Fisher composite wood-and-steel construction is typical of the substantial quality that extends throughout the entire Chevrolet car. Structurally—as well as artistically—Chevrolet is a fine automobile.

Chevrolet prices range from $475 to $650, f. o. b. Flint, Michigan
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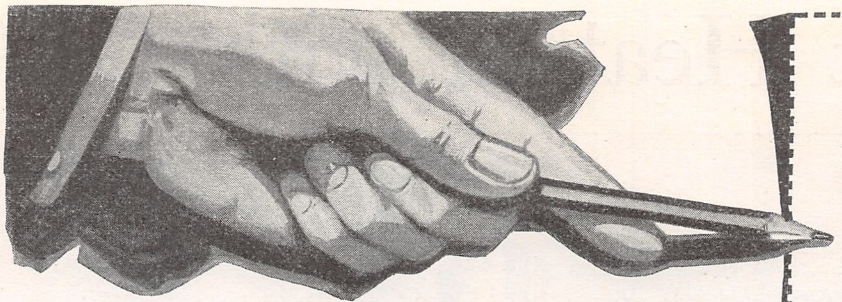

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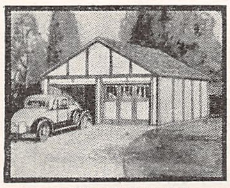

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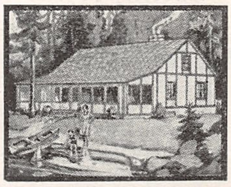

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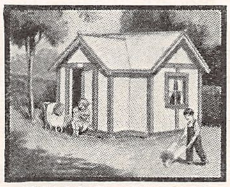

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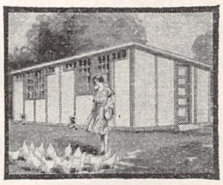

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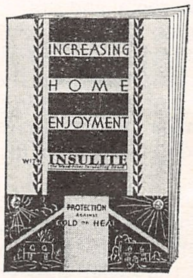

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How About Heating with Oil?

Advantages of automatic burner lie in cleanliness, cheapness of operation, and the ease with which heat is obtained—Fuel available determines the type.

By
COLLINS P. BLISS
Dean, College of Engineering, N. Y. University
Director, Popular Science Institute

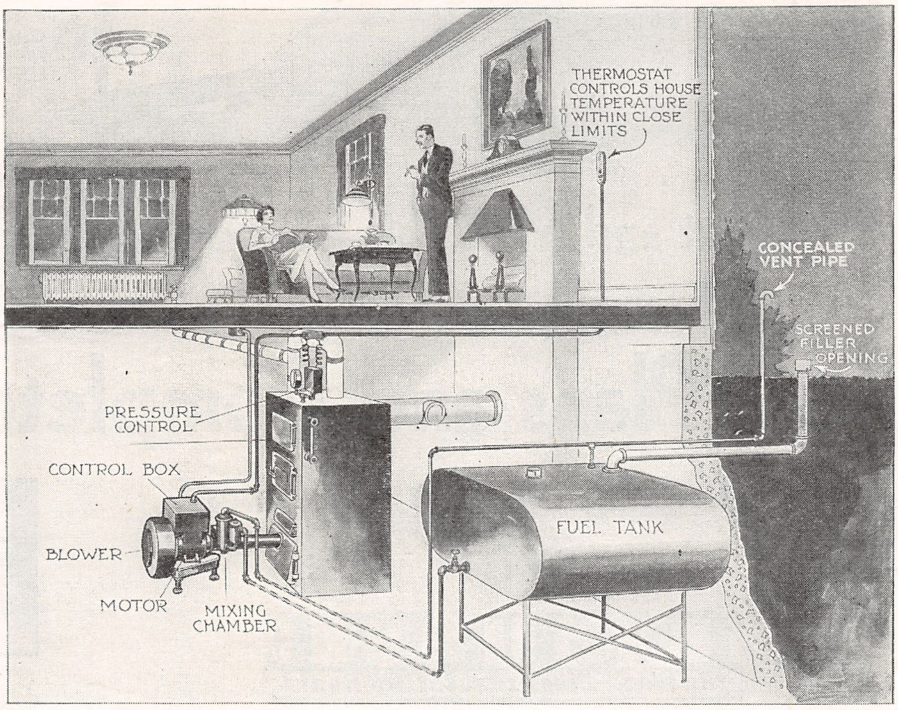

Diagram of a typical installation for heating a home with oil.

TODAY some 500,000 modern American homes are heated by oil. This type of heat has definitely outgrown the experimental stage and has sufficient attractions to justify an increase in its use of nearly 500 percent in five years, according to the U. S. Bureau of Mines. Therefore it is a feature of modern home equipment that is well worth investigation on the part of the man who is building a house or wishes to make his present home more comfortable.

The tremendous appeal of oil heat is that it means the end of shoveling fuel, and that it brings, in the best types of installations, fully automatic heat. An almost-human thermostat can guard the temperature of a room and start the oil burner if it begins to drop. So highly developed is automatic control that the burner can even be set to keep the house at a certain temperature during the day and a different one at night; without attention, day after day, it scrupulously performs this duty.

There are other advantages of heating with oil. It permits a clean cellar, a feature of which many people take advantage by transforming the cellar into comfortable living quarters, thereby adding an extra room to the house. Moreover, oil heat bridges the interval between winter and the milder months when a home owner is reluctant to start a fire. Even though it be for only two hours a day, the oil burner operates automatically and keeps the chill from the house.

KINDS OF OIL

THERE are many fine burners available today and, in making a selection, one feature that governs the choice is the kind of oil available in your locality.

Oils are graded according to their density or weight per unit volume. This is measured by a "hydrometer" somewhat similar to that used in testing storage batteries. The standard scale of density is that of the American Petroleum Institute, consisting of a series of arbitrary numbers or degrees in which the high numbers represent light oil and the low ones heavy oil. The lightest oils used for fuel are thus about "48° A.P.I.," the heaviest about "18° A.P.I."

There is another scale formerly widely used called the "Baumé scale," based on a similar plan. The numbers are so nearly like the A.P.I. ratings that they may be used practically interchangeably, although for exactness the A.P.I. numbers, as standard, are to be preferred. Forty degrees A.P.I. is equal to 39.7° Baumé. Heavier oils show an even closer agreement between the two scales. The systems become identical at 10° A.P.I. or 10° Baumé.

At present about the heaviest oil practicable for domestic use is 24-28° A.P.I., and the possible choice ranges from there up through the lighter oils and kerosene. Heavier oils than those that have been mentioned require pre-heating and are reserved for industrial oil heating.

DIFFERENCES IN PRICE

BURNERS that can use the heavier fuels may effect a considerable saving. Prices in many localities may range from four to eight cents a gallon, for the heavier oils, to eight to twelve cents or more for the lighter ones; in a house that burns, say, 1,500 gallons of oil, this means a possible difference of as much as sixty dollars for the cost of fuel during the heating season. Moreover, the cheap, heavy fuels contain about five percent more heat value than the more expensive lighter ones!

Makers of the light-oil type burners claim certain advantages for them which should not be overlooked. In general, the lighter the oil used, the simpler and more rugged is the burner. Heavy oils are naturally harder to burn, usually requiring more advanced mechanical devices to handle them satisfactorily. Of course the simpler a piece of machinery is, the less chance it has of getting out of order.

Light-oil burners can burn only this fuel and can therefore be used only where it can be purchased. Oil burners for heavy oil will also burn light oil, giving them a wider field.

Besides the all-important matter of selecting the burner according to the fuels available, there are other criteria in making the purchase.

What kind of installations does the local representative of the make of oil burner considered perform? A good burner carelessly installed may use a fourth again as much oil as an inferior make put in with care. The local representative should be able to exhibit several of his burners installed which are giving satisfactory service in homes.

How near is the man who will "service" the burner, and is he readily available on call? Like an automobile, a motorboat, or any other piece of mechanical apparatus, an oil burner may occasionally stop working. If the service man is within speedy call, the inconvenience will be minor. The dealer should be not more than fifteen or twenty miles away. He should be ready to give immediate service at any hour of the day or night. Many a choice between two excellent

(Continued on page 13)

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Refrigeration for the Home*
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HOW ABOUT HEATING WITH OIL?

(Continued from page 12)

burners, one with an alert local service man and the other without, has been correctly decided in favor of the first.

Installing the Burner

The fuel supply system for an oil burner may come from a 275-gallon tank, the largest that the National Board of Fire Underwriters approves for use within the basement, or a tank of from 500 to 1500 gallons or more capacity, buried outdoors.

The larger sizes, 1000 to 1500 gallons, are much to be preferred for buried tank installations. Since these sizes may be, roughly, the equivalent of from 8 to 12 tons of coal, they reduce to a minimum the need of replenishing the fuel supply frequently. Moreover, in some localities, the owner has the advantage of being able to buy his oil at a "tank-wagon price" from ½ cent to 1 cent a gallon lower than his neighbor with a small tank.

In localities where oil companies have well-established delivery service the smaller inside tank has some advantages; it costs less, the equipment is more easily serviced, and with some types of burners additional equipment is dispensed with in the form of a pump.

Underground storage requires some sort of pump to transfer the fuel to the burner, and this is either a pump integral with the burner or a separate unit in the basement—either electric or hand-operated. Electric pumps are automatic and require no attention to keep the supply of oil flowing. An auxiliary tank within the basement is optional with many systems; it is not necessary, and the less oil-handling equipment in the cellar the less chance there is of oil leakage.

The installation of the burner itself in furnace or boiler is a job that calls for the attention of an expert, as a slight change in bricking in the fire-box with refractory material to direct the flame properly may alter the efficiency of the whole system materially. A good installation man knows just how best to adapt a burner to a particular heating boiler, and for that reason it is of paramount importance to select a make of burner represented by such a man.

Care of the Burner

Beyond seeing that it is kept clean and that parts requiring lubrication are properly oiled—many oil burners require this attention but once or twice yearly—the less a home-owner has to do with his burner the better. With such routine care a burner should give excellent service, and any mechanical trouble calls not for tinkering but for the service man. Of course this implies the exercise of some intelligence. Often the man who is most careful about keeping his car's tank full of gasoline reaches at once for the 'phone when his oil burner stops without warning—and it turns out that the oil is used up.

Occasionally—once a year, say—the underground tank may require cleaning to remove water that has settled out of the oil. This will keep the bottom from rusting through, and is performed by dropping a hose down the fill pipe or test well and pumping it out. Indoor tanks have a bottom plug removable for draining and cleaning.

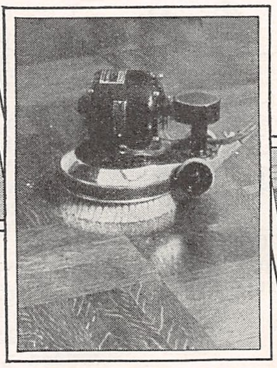
This One Unique Floor Machine

Polishes

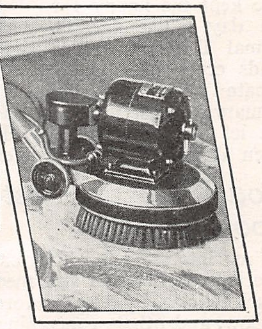
The electrical way of doing over floors. Plug into an electric light socket like a vacuum cleaner. You don't even push or pull—you merely guide the machine.

Scrapes

Takes off the old dingy shellac or varnish and sandpapers the wood to velvet smoothness.



Waxes the floor and then polishes it. Result is far superior to handwork and you use much less wax.



Scrubs

Here's the way to clean tile, cement or marble floors. Fast. Efficient. No back-breaking drudgery. No splashing.

COSTS but a FRACTION of what a contractor would charge for doing over your FLOORS . . . so amazingly SIMPLE you operate it YOURSELF

You'd be surprised how beautiful your floors *could* be.

They may look dingy and disreputable now, but how they'll gleam and glisten when done over the *electrical* way.

Instead of pulling rugs over the ugly worn spots, as you may be doing now, you'll be so proud of the lovely finish that you'll hate to cover up a single inch.

Can't you picture how much better your furniture will look . . . and your draperies . . . and rugs!

Can't you just hear your friends asking whether you've had a *new* floor put down?

How amazed they'll be when you tell them that you actually did over your old floors *yourself* . . . that the marvelous improvement was entirely due to *your own* efforts!

Yet that's just what you *can* tell them. The Ponsell Electric Floor Machine enables you to scrape, sandpaper, wax and polish your old floors without bringing a single workman into your home.

Too good to be true? Not a bit of it. That's only *one* of the advantages. In addition, you save money because the machine costs but a fraction of what a contractor would charge you to do over your floors.

Then too, the machine refinishes your floors in such a way that they are no trouble at all to keep looking beautiful all the time.

It's astonishing how quickly and easily floors can be done over with the aid of electricity. The *head*-work YOU do; the *hard* work you leave to the machine.

You plug into a socket just as you would with a vacuum cleaner. In a few minutes you are running the Ponsell like an expert and your floors are on the way to a vast improvement.

Good-bye, Drudgery!

When floors are done over by ordinary methods they have to be refinished every few years; and it is no easy task, as you well know, to keep them looking presentable from day to day.

But when you do them over the Electric way, you never have to refinish them again and, what's more, the machine takes care of them for you forever after.

FOR YOUR BUSINESS, TOO: Thousands of leading firms keep their floors spick and span with the Ponsell. Far cheaper than hand labor. Write for information. See coupon below.

TEAR OFF . . . FILL IN . . . MAIL TODAY

Ponsell Floor Machine Co., *Dept. P. S. 431*
220-30 West 19th St., New York City

Please mail me complete information regarding your Electric Floor Machine.
I am interested in { business / residence } floors.

Name..........
Address..........
City..........State..........

P. S. 431

Our Readers Say

Himself, in Person; Your Artist!

Some of your contributors to the "Our Readers Say" page sing the praises of your cover designer. I wish to voice appreciation of the efforts of the anonymous artist who makes life worth living by his witty and apt illustrations to the printed comments. Some months ago there was a sketch of a chap blowing over a curved piece of paper. That little picture kept me happy for the day. The terrible animal illustrating "He heads crusade to exterminate autos" in the January number is almost as tickling. Why not let us see what this fellow looks like when at work.—S. J. M., Toronto, Can.

You Knockers, Just Look at This

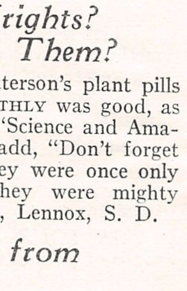
I am interested in all forms of science but especially in aviation and mechanics. I like your articles by Assen Jordanoff, Randy Enslow, and others concerning aviation, also Gus and Joe's auto department. I like your "Readers Say" page, but I can't see why some people can be so conceited as to want you to discontinue publishing everything that they don't happen to like, and publish only what suits them. They evidently think that the world was made for them and that everybody else should try to please them. Neither do I agree with H. H. when he tries to run down aviation and monorail trains, or any other invention. I think he should learn something about both before he tries to criticize them. As for his "rubber cows," well, they have their advantages and disadvantages just like everything else but they are a subject in themselves too long to be taken up here. But me for the "heavier than air craft," the airplane.—R. R. M., Clearwater, Kan.

Remember the Wrights? Who Can Forget Them?

The article on Mr. Patterson's plant pills in Popular Science Monthly was good, as was also the editorial on "Science and Amateurs." I would like to add, "Don't forget the Wright brothers. They were once only bicycle mechanics but they were mighty good ones."—J. A. McG., Lennox, S. D.

A Problem Right from A Midshipmite

Here's one for your readers: Cut notches along one edge of a one-foot stick. Make a small flat propeller, put a hole in it, and fix it to one end with a tack so that it can revolve. Now rub along the notches with another stick and the propeller will revolve merrily. A little experimenting will show how to reverse its motion. The question is, why does it spin? Won't someone give me light on this?—E. S. Q., Annapolis, Md.



He Finds No Magic In the Plant Pills

I noticed the article, "Homemade Plant Pills Grow Crop in Sand Hill," in Popular Science Monthly. I note you state that the experimenter, Mr. Patterson, was unable to secure "plant pills" on the market. Evidently he is not familiar with fertilizers or the use of same or he would have known, or could have found out readily, that "plant pills" have been manufactured and sold by various concerns for the past ten or fifteen years. Further, from a scientific standpoint, there is no difference in results secured between plant food made in pills or when pulverized, because all plant food has to go into solution before it can be used by the plant. The advantage of Mr. Patterson's method was undoubtedly due to the fact that he placed tar paper at the bottom of the trench to prevent water from escaping too readily, as it would do in this type of soil; then his mulch prevented undue evaporation. There is nothing magical in what Mr. Patterson has done.—A. E. G., Richmond, Va.

Give This Little Man A Great Big Hand!

I read that "cute" editorial "He Will Not See," and although I do not agree with the clergyman entirely, I think you are "all wet" on some of your views. Of what advantage, when all is said and done, is our modern industrial system when it allows periodic depressions and conditions of social and economic unrest? Of what advantage are our wonderful installations of labor-saving machines when they throw out of work (in the long run) more men than their creation replaces? Of what advantage are the efforts of our men of science and medicine who work to prolong life only to see their efforts go for naught due to bungling statesmen and diplomats who hurl their country into either a wasteful war or ignominious and treacherous agreement? I hate to croak, but when good times return, it will be the old cycle once again, then crash! Another slump, and more row! Until depressions are licked, and there must be some way to lick them, all this talk about social progress is just so much hooey.—E. D. C., Hartford, Conn.

Wants to Build Miniature Theater

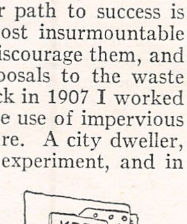
I am greatly interested in the construction and operation of the miniature theater, and I should be glad to see in Popular Science Monthly a series of articles dealing with the subject. Such things as directions for construction, lighting, scenery, properties, effects (mechanical), et cetera would be of great help. I should be much obliged if you would print this letter in the "Our Readers Say" department as I am sure that there are many other subscribers interested in this who would like to add their voices to mine in requesting such a series of articles. All together now; how many want them?—B. K., Philadelphia, Pa.

To Preserve It, He First Dissects It

For several years I have been a reader of Popular Science Monthly. I secure it each month at a newsstand and enjoy it to the utmost. In all the years I have had the magazine I think the January, 1931, issue the best. If it improves each year in the future as it has in the years I have had it, it will soon have to be added to the seven wonders of the world. Along with others I would be glad to see two or three columns of chemistry a month, but don't change the nature of the magazine or much of its value will be destroyed. Keep it POPULAR Science. Being a teacher, and by nature of changing habitats, it is impossible for me to keep the whole magazine, and therein lies my tale. Is there no way that the pages may be prepared so that they may be removed more easily? Now, after reading the issue through, I have to remove the staples and then dissect the works, removing to my files the many articles I desire to save. Won't you please try and think of some way to save me all of this destructive and annoying labor?—L. S. S., Coxsackie, N. Y.

Do Slammed Gates Hurt the Amateurs?

Your editorial, "Science Needs Amateurs," leads me to the reflection that amateurs do not get a square deal from the scientific world. Amateurs are seldom recognized until they make good and their path to success is usually blocked with almost insurmountable obstacles. Their friends discourage them, and experts consign their proposals to the waste basket. For instance: Back in 1907 I worked out a plan to farm with the use of impervious paper to retain the moisture. A city dweller, I had no opportunity to experiment, and in 1922 I gave my idea to the United States Department of Agriculture and the University at Lincoln, Nebr., and to one of the large farm papers. The editor said he didn't think much of the idea. The University said it sounded all right but did no experimenting. In 1924 the Department of Agriculture began experimenting with the result that my theory was



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Evidence!

These letters disclose successful treatment of LOOSE DANDRUFF and other scalp troubles . . . .

WHERE can you find better evidence of the value of Listerine as a treatment for scalp troubles and loose dandruff, than letters from men for whom Listerine has ended such conditions?

Below we print some of the many hundred of enthusiastic letters we have received on this subject. Read them. You may find a solution to your own problem.

Remember that the Listerine treatment is simplicity itself. You simply douse it on the scalp full strength (as a part of the shampoo or independent of it) and follow with vigorous massage. You will be delighted to see how quickly you get results. Lambert Pharmacal Co., St. Louis, Mo., U. S. A.

Ended Dandruff Quickly

Dear Sirs:

When I graduated from college and went into the bond business, the matter of my personal appearance was of prime importance and falling hair and dandruff added nothing to my neatness. Upon the advice of my barber I purchased my first bottle of Listerine. The first bottle did not totally stop my trouble, but successive applications soon got to the root of the evil and today I have no scalp trouble at all.

Very truly yours,
(Signed) Marshall Lewis,
Philadelphia, Pa.

Doesn't Fear Inspection Now

Dear Sirs:

Every man in Uncle Sam's Navy knows how hard it is to keep the blue uniforms spotless. Several months ago I was handicapped with a bad case of dandruff. I had tried various remedies but to no avail. One day I noticed an advertisement wherein it was stated that Listerine would kill 200,000,000 germs in 15 seconds. Right away I made a trip to our canteen and purchased a bottle.

I used it freely every third day, and today I have hair free from troublesome dandruff. It certainly is a relief to know that when I put on my best suit of "blues" for an inspection, that I will not have the shoulders spotted with flakes of dandruff. More power to Listerine!

(Signed) D. G. Rorie,
U. S. S. Utah

No More White Flakes

Gentlemen:

The plumbers had turned off the water in my San Francisco apartment. I prepared to shave and so discovered this fact. I couldn't shave and, worse yet, I had nothing with which to "plaster down" my hair. For years I had used water for this purpose and for years I had had dandruff which I regarded as a necessary evil. I opened the medicine chest to see if it contained anything I could use for the purpose and Listerine seemed to be the only thing at all eligible.

Soon after I noticed my dandruff was disappearing. The scaly white flakes no longer dotted my coat collar. I am never without Listerine now and I use about one large-size bottle per month for my hair alone. I have not used water on my hair, except when washing it, for almost ten years.

Very truly yours,
(Signed) Victor L. Klee,
Los Altos, Calif.

New Hair Came In

Dear Sirs:

I had been troubled with dandruff for years, but gave it no special attention, merely washing my hair when it seemed necessary and when the dandruff became unbearable. I also noticed that a great deal of hair came out in the comb, but felt relieved rather than worried to think my hair was thinning out.

One day I discovered a bald spot, the size of a quarter, at the crown of my head. To my mind there is nothing so disfiguring as baldness, so I began a search for a remedy. I noticed a Listerine advertisement in my magazine, so stopped in the drug store on my way home, bought a bottle, and began the Listerine treatment that night.

I used a little sweet oil and massaged Listerine into the scalp, working vigorously. I then washed my hair with castile soap, hoping I was on the right track. I used Listerine three times a week after that and the dandruff began to clear up immediately and after the second week less hair came out. I kept this up for several weeks and one day seemed to see fine hair growing in the bald spot. This encouraged me more than anything, and my Listerine massages were more vigorous and enthusiastic than ever.

Now, the hair in my "bald spot" is almost as thick as on the rest of my head. I use Listerine once a week and it keeps my hair in splendid condition, checks the dandruff and increases the growth of new hair.

Yours very truly,
(Signed) Philip I. Russell
Chicago, Illinois

Hair Was Thin

Dear Sirs:

Dandruff caused me great uneasiness. So I purchased a large size bottle of Listerine and used it twice a week for five weeks. Before the bottle was exhausted a plainly perceptible improvement in my scalp rewarded my efforts and the continued use of Listerine has produced for me a perfectly healthy scalp, free from dandruff, the natural result being thick, healthy hair of improved color and texture.

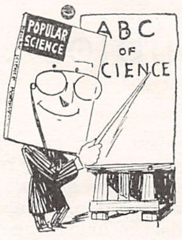
Very sincerely yours,
(Signed) Virgil W. Burgess,
Champaign, Illinois

**Don't miss BOBBY JONES
King of Golf
LISTERINE HOUR
Every Wednesday Night
WEAF and a coast to coast NBC network**
See your local paper for time

proved correct. The foregoing is written to emphasize the point that millions have been donated to colleges but nothing has been done to make it possible for the amateur to work out his ideas without becoming a martyr to them. I should very much like to see things made a little easier for the amateur who has a good idea and would be glad of a chance to develop it.—J. A. LaB., Chicago, Ill.

Not Enough Is Better Than Too Much

As to your magazine I have but one criticism—it is that you are not technical enough to make all of your explanations perfectly clear. It is evident that your reason for this fault is to make your articles readable by the layman, so a criticism without a means of correcting the new fault which would arise with the correction of the old would be null and void. I do not stop at this point but make, at this time, a suggestion which I think is plausible. It is that Popular Science Monthly publish in the future a series of lessons in science by some good authority. These lessons would cover the same material as does a high school course in natural and physical science and would, if the writer so desires, contain experiments along this line. This would make it possible for you to publish better articles.—C. S. M., Detroit, Mich.



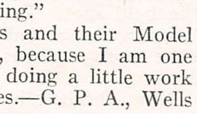
He Gathers Profit from Gus and Joe

This is my fourth year with Popular Science Monthly and I haven't been able to find a fault in that time. I think your articles all worth reading but I haven't seen as much of the "racing game" as I would like, especially "auto racing."

I enjoy Joe and Gus and their Model Garage and profit by it, because I am one of the many who enjoy doing a little work on their own automobiles.—G. P. A., Wells River, Vt.

Who Started This Nut Thing, Anyway?

Your correspondent who proposed the nut problem in the December issue of Popular Science Monthly did not fairly test the scientific mind of your readers. The original five men problem stipulated that the sixth division gave each of the five men an *equal number of nuts* (no odd nut for the monkey). With this condition imposed, L. T. B's. formula in the February issue is incorrect except for the minimum number of nuts or when n=1. Here is an interesting modern version of this old problem conditioned as above. "It happened that seven sailors and a monkey were marooned on an island. They spent the first day in gathering coconuts. It happened that each sailor mistrusted the others, so each one stole out during the night to get his share. Each divided the pile he found into seven equal parts and hid his share. In each case there was one odd coconut which was given to the monkey. On the following day they met and divided the remaining pile into *exactly seven equal piles* (no odd coconut for the monkey). What is the third number of coconuts in the series that fulfills the condition that the last division left no odd coconut for the monkey?"—H. F., Tullahoma, Tenn.

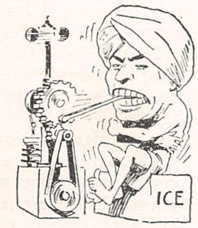


That Fish Problem Just Isn't a Problem

The question that H. G. of Plaquemine, La., submitted is no problem. Water is a chemical combination of hydrogen and oxygen in the proportion of two to one. Fish cannot break water up into its constituent elements but there is oxygen dissolved in the water from the air which they can remove and use for respiration. A fish placed in a sealed glass bowl would live until it had removed the dissolved oxygen, after which it would die but the remaining liquid would still be water. P. M. D. of Luseland, Canada, has the right idea when he says keep the present articles to satisfy everyone and if anything add some other interesting subjects. I have built several models and at present am working on a model of the Fokker F-32, using my own plans. I would like to see some plans for fuselage models. Your article on "Better ways to Build Wings for Model Airplanes" was interesting and helpful. Anything along that line will be appreciated.—N. E. F., Rutherford, N. J.

India Produces a Chattering Inventor

I am so keenly interested in your beautiful magazine that I cannot leave it even for a moment till I finish every page of it. "Flops of Famous Inventors" was grand. It gives a lot of encouragement to the budding inventors, who need not be disappointed at their failures. In this connection it may be interesting to note that I too once had an idea of inventing an engine resembling the vocal engine of Thomas A. Edison. This was the way of it. It was the mid of winter and I was at a boarding school, we were urged by the teachers to get up early and while waiting for the bath our teeth chattered consistently. (Please do not be under the impression that winter is never cold in India.) It occurred to me that this energy may be utilized by means of a very simple machine in which an oscillating rod be clamped to the lower teeth and the other end be connected to a ratchet wheel which will revolve as the teeth chattered. It also seemed to me that the teeth chattered without any muscular effort on my part. Of course I had no idea of securing a patent because I myself was aware of the folly of such a contrivance, but it was a source of great amusement when I disclosed my invention upon my friends and they nicknamed me "the chattering inventor."—R. H. M., Rewa, India.



Come, Knit Your Brow At This Grazing Cow

I would like to submit to your readers a little problem that I have found rather interesting. It can be solved by calculus, but I am anxious to know if anyone can supply a solution by some other method. Here is the problem: A cow is tied to a post on the circumference of a circular field 100 feet in diameter. How long must the rope be in order that the cow may graze over one half the area of the field?—W. H. O., Santa Ana, Calif.

Growing Aviation Demands More Space

I have noticed with mounting ire the letters of some contributors who state that there is "too much aviation" in the magazine. Perhaps they wonder why so much space is given to aviation in not only your magazine but many others. The answer is that aviation is such a rapidly growing industry that new developments of great interest are constantly appearing. Some day it will slow down but until then it will continue to hold more interest than any other industry. When the railroad and automobile were young, each was given a great deal of attention, but now aviation holds the public eye.—H. R. R., Jr., New Orleans, La.

Would Heating System Change This Old World?

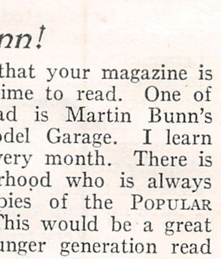
Your article on heating a home by reversing the process of the electric refrigerator was timely and well chosen. While thousands of people have caught a fleeting vision of the same idea, since the first electric refrigerator was invented, you are the first to call attention to its practicability. The main difficulties, technical and otherwise, that occurs to one when first contemplating the idea are: (1) The original cost of installation; (2) The difficulty of keeping the outside evaporating coils defrosted (in moderate weather—to say nothing of storms); (3) The danger of leakages from the inside compressor and condenser and the difficulty of getting perfect operable valves for shut-off; (4) The possible effect of weather conditions being altered by a universal adoption in large centers like New York—or new storm centers created. With sufficient funds for experimental work, I believe no difficulty presented would be insurmountable. What a boom for business and boon to unemployment it would be!—J. W. D., Harmon, N. Y.

Stop Blushing, Mr. Martin Bunn!

Would like to say that your magazine is the only one I take time to read. One of the first things I read is Martin Bunn's articles about the Model Garage. I learn more about my car every month. There is a kid in the neighborhood who is always bothering me for copies of the Popular Science Monthly. This would be a great country if all the younger generation read Popular Science Monthly.—R. H. L., Nutley, N. J.

Ben Franklin Tried To Answer This One

Popular Science Monthly makes frequent reference to white paint, aluminum, linen, etc., being used in some manner to "reflect" the sun's rays. How do we know that white reflects the rays and that black absorbs them? Is it not true that the sun's rays are electricity in some form? When they strike the black opaque object are not the electrons dashed to pieces by its resistance, while the white and transparent surfaces absorb the rays of light in varying degrees? As an example: The rays pass through window glass and heat the first object that resists and breaks them up. There is no heat whatever in the sun's rays until they are broken up by striking some object. It is ridiculous to say these rays can retain heat while passing through 92,000,000 miles of absolute cold. It would be just as reasonable to say that the heat given off by electrical apparatus in the home comes, red-hot, over the wires from the power station.—G. E. J., Montreal, Can.



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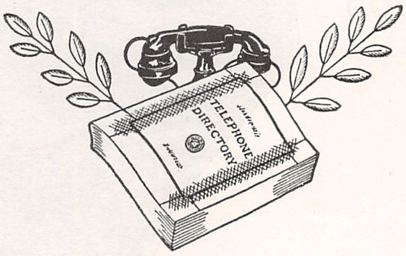


A GREAT MANY PEOPLE will tell you that the biggest single service that five cents can buy today is a local telephone call. Without question, it is big value . . . and value that steadily grows as new telephones come into your neighborhood.

There are times when telephone service is priceless . . . when the ability to call instantly a doctor, a policeman, or the fire department could not be measured in terms of money.

But it is not alone the emergencies that give the telephone its value. There are the commonplaces of every-day conversation . . . in the home, the shop, the office . . . whenever you wish two-way communication with any one, almost anywhere.

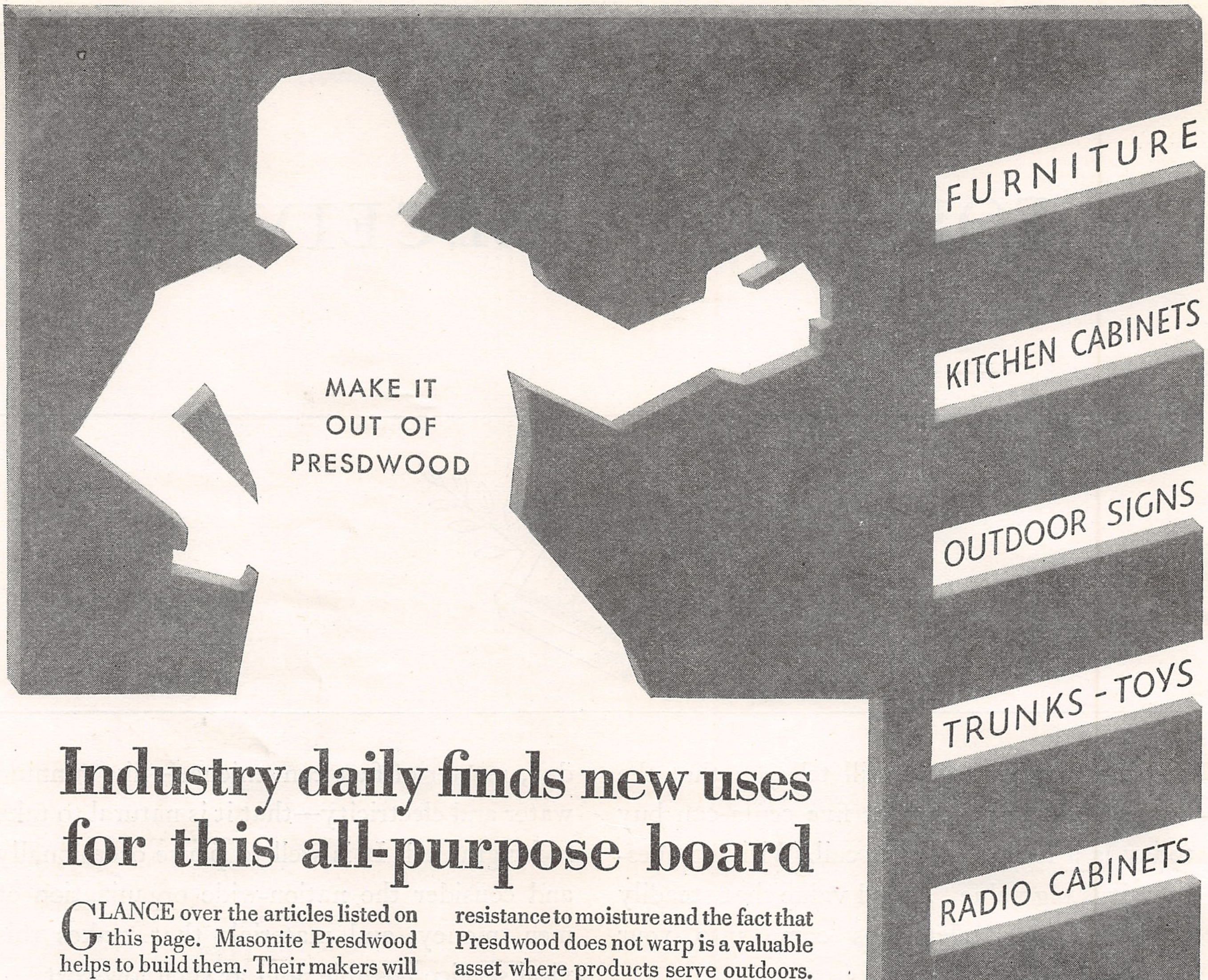
The telephone has become such an every-day, matter-of-fact convenience—like running water and electricity—that it is natural to take it for granted. It is well to pause occasionally and consider the nation-wide organization of men, money, and materials that makes this vital service possible, and at such low cost.

Here is a system of the public, for the public . . . run on the barest margin of profit consistent with service, security, and expansion. A service that grows as the community grows . . . placing within the reach of an increasing number the means to talk back and forth with people in the next block, the next county, a distant state, a foreign country, or on a ship at sea!

No other money that you spend can bring you more actual value.

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★

AMERICAN TELEPHONE & TELEGRAPH CO.
BELL SYSTEM
AND ASSOCIATED COMPANIES



Industry daily finds new uses for this all-purpose board

GLANCE over the articles listed on this page. Masonite Presdwood helps to build them. Their makers will testify that, with Presdwood, they are better and more durably built, at a decided economy in manufacturing cost.

Presdwood is a versatile product. Each day brings new uses, and each new use suggests another. Its users quickly endorse the idea of "making it out of Presdwood." Somewhere in your own business, very likely, Presdwood can be of service to you . . . and it will serve you well.

Smooth, grainless, and attractively finished, Presdwood comes in boards up to 12 feet long, or cut to order. It can be sawed, punched or drilled, and will not chip, crack, split or splinter. Its resistance to moisture and the fact that Presdwood does not warp is a valuable asset where products serve outdoors.

In construction work, Presdwood lines concrete forms and produces concrete that needs no expensive hand-finishing. In the home, it makes beautiful wall and ceiling panels, turns waste space into delightful living quarters, helps the handy-man in any number of odd jobs.

Write for the helpful Presdwood booklet. No cost; no obligation. Lists 80 of its many uses and the best ways to apply finishes, which Presdwood takes so well. Simply send coupon. Your lumber dealer will be glad to tell you about Presdwood.

MASONITE CORPORATION
111 West Washington Street • Chicago, Ill.

Masonite

STRUCTURAL INSULATION • INSULATING LATH
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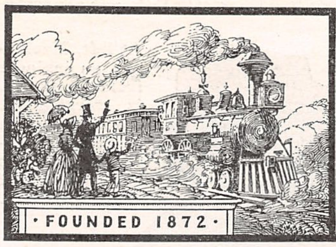


POPULAR SCIENCE MONTHLY

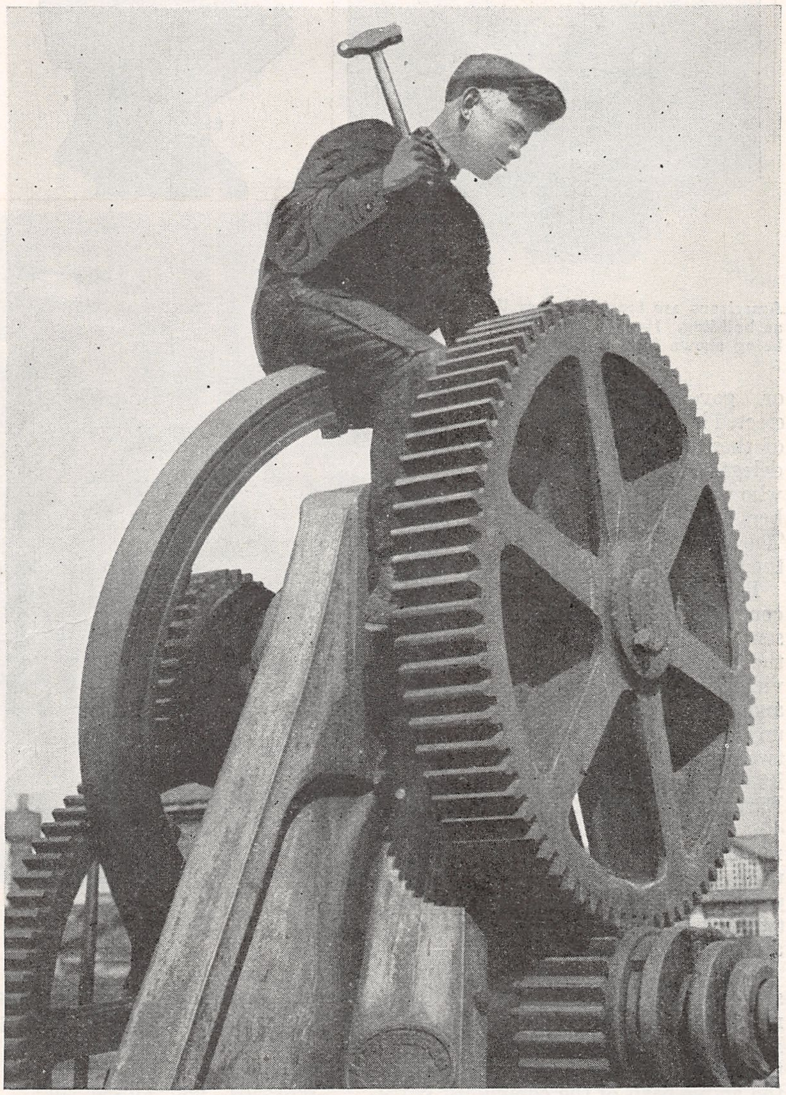
FIFTY-NINTH YEAR

April, 1931 · RAYMOND J. BROWN — *Editor* · Vol. 118 No. 4

Is New Russia

Built by Americans

A World Menace?



By MICHEL MOK

TWO thousand American engineers have undertaken the biggest job in history. They have been hired by the Soviet government to direct work designed to turn Russia into a world industrial power in five years' time.

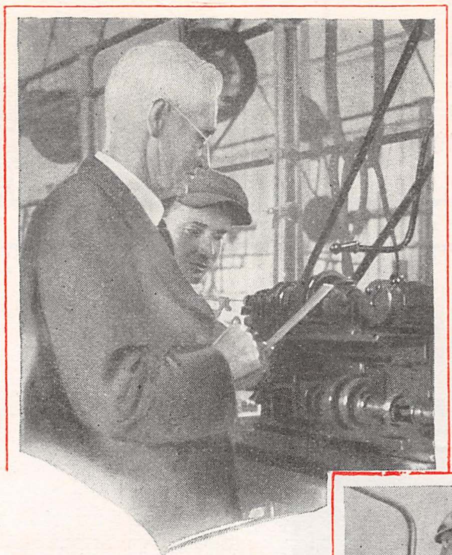
These Americans are helping the Soviet transform a country that covers one sixth of the land surface of the earth into a great modern factory. By converting a population of 160,000,000 into one huge army of workers and investing $32,000,000,000, the Soviet aims to change a backward country into an ambitious nation.

This gigantic scheme, put into operation in 1928, is known as the Five-Year Plan. You can know what the plan is and what it aims to do only by knowing how Russia is now governed.

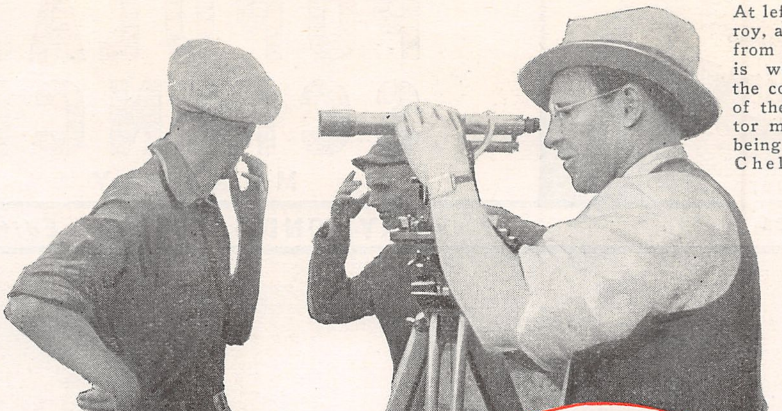
As a matter of fact, there is no "Russia." That vast domain, consisting of more than 8,000,000 square miles and including almost half of Europe and one third of Asia, now is called the U. S. S. R. —the Union of Socialist Soviet Republics. It is ruled by the working class. This means that about 1,600,000 people control 160,000,000—one percent boss the rest.

This ruling group of one percent is the communist party. Only workmen and peasants have the right to vote. All key offices in the government are held by communists. The party completely controls the army and navy.

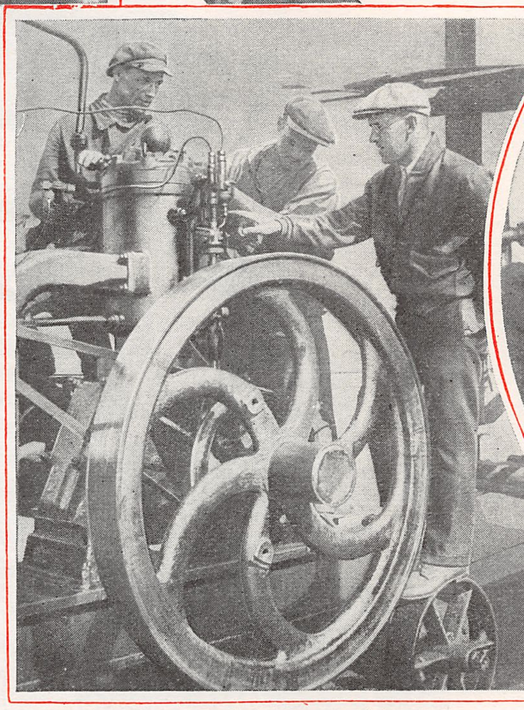
The communists came into power in 1917, shortly after the overthrow of the Czar. When it took hold of the government, it divided the old empire into six principal republics. These are governed by a system of soviets, or committees. It's like this: Imagine the United States cut up into six large states. Every village, town, and city would have its own soviet,



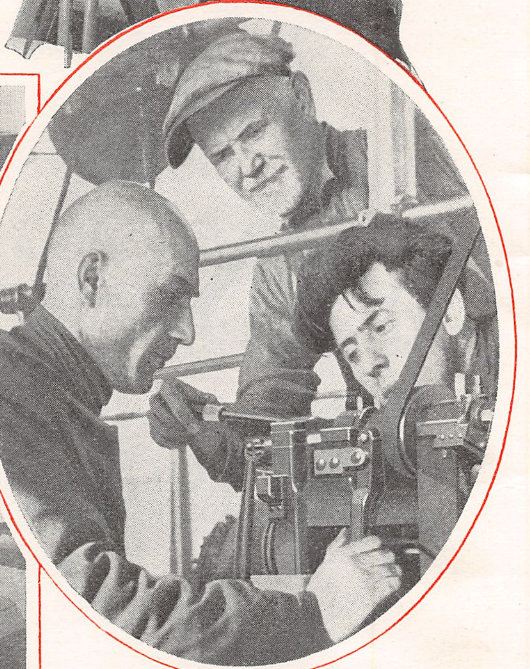
Americans are teaching as well as building. Here a Russian is being shown how to use tools.



At left, Mackleroy, an engineer from America, is working on the construction of the big tractor mill that is being built at Cheliabinsk.



American Engineer Shwemler, at right, is instructing Russian workers in the way to care for an engine.



Even in watch making the Russians are receiving help from the American specialist.

or governing committee, elected by the people. Each of these soviets would elect delegates to a county soviet, who would choose the members of the state legislatures. They, in turn, would elect the Congress in Washington.

Russia, however, has no congress in the American sense. At the top stands the Union Congress of Soviets, with between 2,000 and 3,000 members. This unwieldy body meets every two years, and elects, from its own number, a Central Executive Committee of 400 commissars. The commissars elect a smaller executive committee called the presidium and having twenty-one members. These are the real rulers.

Joseph Stalin, dictator of Russia, is secretary of the Central Executive Committee and a member of the presidium. He derives his great power from the fact that he is also the secretary-general and the active head of the communist party.

This has been Russia's form of government for the last thirteen years. Throughout that period, the communist party has been in power. Communism supports state ownership of land, natural resources, and control of production and distribution. In a communist state, there is no private property, no private wealth, no personal profit. All citizens are either government employees or government pensioners. Russia is the only country where communism ever has been tried out on a large scale and for any length of time.

Communism is directly opposed to capitalism, the system prevailing in all other countries, by which property is owned privately and the individual reaps the rewards of his own efforts. Socialism has the same aims as communism, but it seeks to achieve them by means of legislation instead of revolution. Thus, a communist, as some one has said, is merely an impatient socialist.

The father of modern communism was Karl Marx, a German sociologist, who died in 1883. The original leaders of the 1917 Russian revolution, Nikolai Lenin and Leon Trotzky, tried to put Marx's ideas into immediate practice. The new government took over all factories, mines, railroads, and closed all private shops and banks.

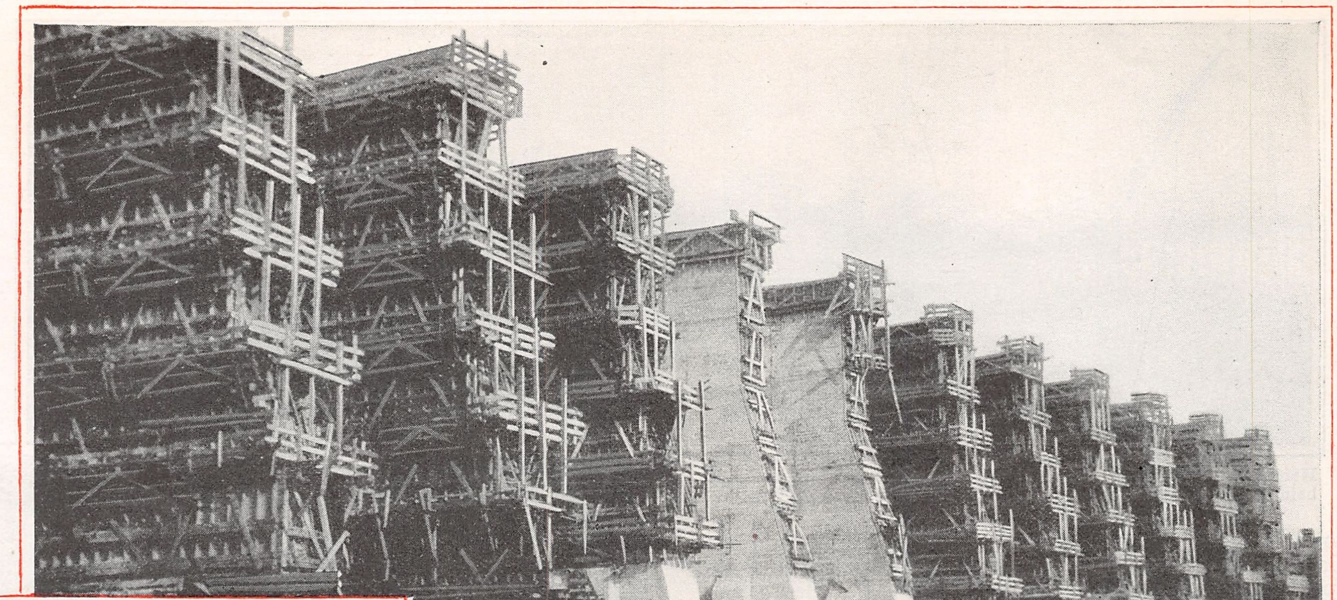
Four years of civil war followed. The government could not run the industries and the railroads. The peasants refused to work the land and in 1921, a famine wiped out more than 3,000,000 people.

Russia was exhausted. Lenin admitted failure and put into effect a new system, a compromise between communism and capitalism. Trotzky, bitterly opposing this, was exiled. The government now ran industries for profit and allowed private enterprise to reëstablish itself.

Shops and banks were reopened, farmers went back to work, industry revived. Stalin took Trotzky's place. The new system was a clever truce; Lenin and Stalin said again and again that Marx's ideas had not been abandoned.

After the death of Lenin in 1924, his plans were carried out by others. By 1927, the country was again on its feet. Stalin then became the man of the hour.

American engineers for Russia: M. D. Connor, C. W. Showen, R. G. Harpold, K. B. Vail, J. A. Connor, R. H. Wilson.



The giant dam being built under the direction of the American engineer Col. Cooper, on the River Dnieper, Russia, which when finished will be the world's biggest electric plant.

Col. H. L. Cooper, in charge of the hydroelectric project on the Dnieper.

A NEW Russia is in the making. The Soviet, almost overnight, is changing a backward country, three times the size of the United States, into one great factory. Whether the forces thus unleashed will work out for good or for evil remains to be seen. Meanwhile, this amazing experiment claims the attention of every American.

IN A series of impartial articles, of which this is the first, this magazine will give you a picture of Russia as it is today. What is happening in Russia? How are Americans helping Russia? What will success in Russia do to us in America?

—The Editor.

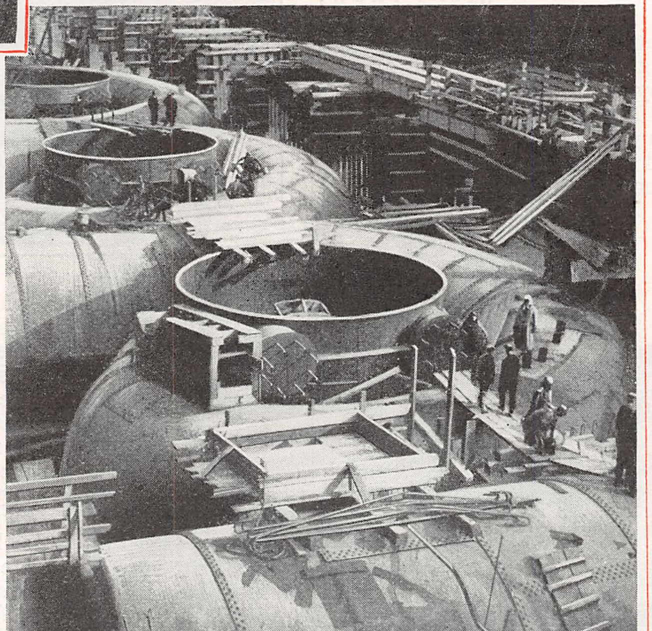
He saw that the time had come for another effort to make Lenin's old ideas work.

But Stalin went about it in a new way. He realized that, if communism were to succeed, it would have to be put in use quietly, without panic or hysteria and without unduly alarming the rest of the world. He knew, too, that, if the government was to run the nation's business, it must first learn how the capitalists did their jobs.

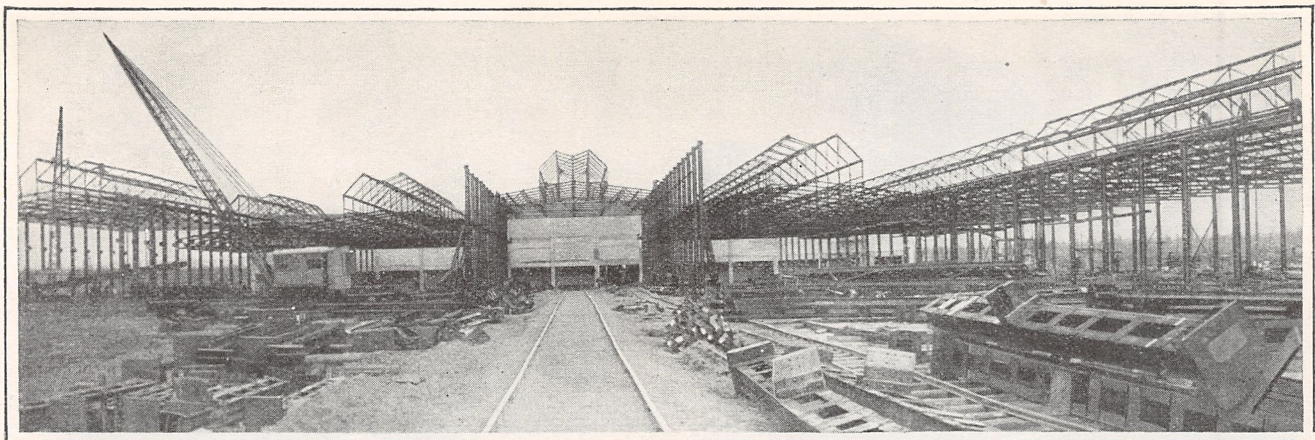
So first he had to make friends with the so-called capitalist countries and with the great industrial and business concerns in these countries. Then he named a State Planning Commission, composed of experts, and demanded that a scientific plan be worked out by means of which, in five years, Lenin's ideas could be put into practice.

This was done. The plan in brief is this: By 1933, the Soviet means to double Russia's steel, oil, and coal production, triple its metal output, and quadruple its manufacture of machinery. The Soviet has no credit in other countries. To buy foreign machinery and pay foreign experts, it must export huge quantities of grain, manganese ore, and lumber. To speed up the grain output, the Soviet is throwing small farms together into big farms, worked with jointly owned animals and tools and with government-supplied machinery.

All land in Russia now is



Above is a view of some of the giant turbines, biggest ever built, and made in America, to generate power at the Dnieper plant.



Here is a general view of the assembly shop, 2,000 feet in length, being built as part of great automobile works at Russia's "Detroit."

owned by the state. Farmers get free land grants so long as they work it and pay taxes. Last October, 6,000,000 families were working such big farms. In addition, the government now runs more than 3,000 state farms. By 1933, all farm land in Russia is to be worked either as joint community farms or as state farms.

To execute its big Five-Year Plan the Soviet has the man power, the cash, and the necessary iron, coal, oil and other natural resources.

BUT it has no officers capable of directing this great work. The Russian engineer lacks the necessary training and experience. That is where the 2,000 American engineers come in. The Soviet government admits that they are indispensable to the success of the Plan. Without them, it could not be done. In fact, the Russian leaders recently issued an S O S for several thousand more Americans.

Besides, Russia has no machinery. Forty of the biggest American firms are supplying that need. Among them are the General Electric Company, the Ford Motor Company, the Newport News Shipbuilding and Drydock Company, the Austin Company of Cleveland and New York, the Du Pont de Nemours Company, the Radio Corporation of America, and the Sperry Gyroscope Company.

Half of the American engineers in Russia are employed by these firms. The other thousand are working directly for the Soviet government. Aside from the Americans, there are at least 1,000 other foreign engineers at work, among them Germans, Italians, Swedes, and Czecho-Slovakians.

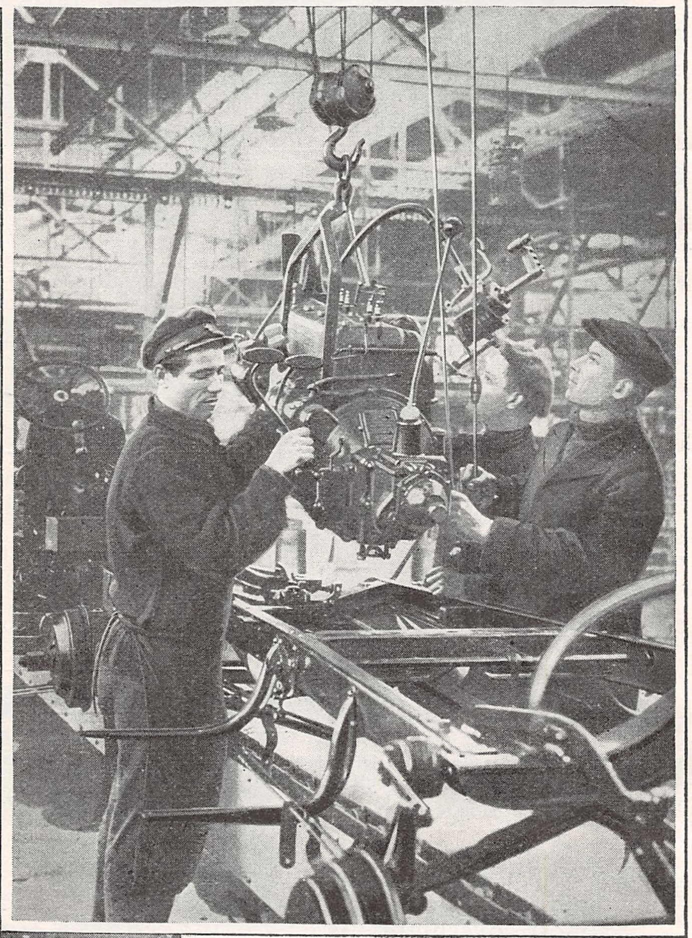
But Americans are in charge of the biggest jobs. American brains and initiative are directing this giant show, played upon a stage three times the size of the United States.

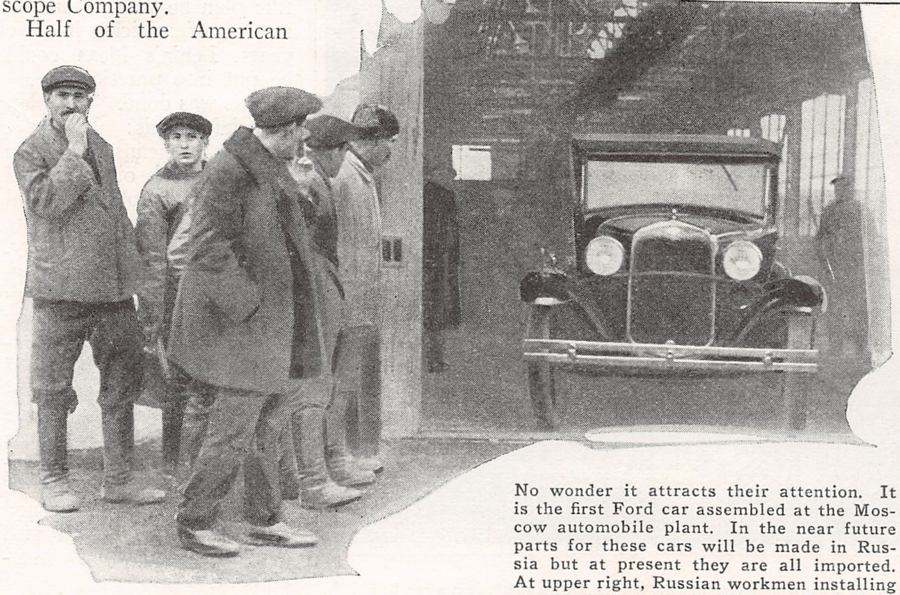
Thousands of miles from home, among a people most of whose ideas are as foreign to them as their language, engineers from New York, Cleveland, Detroit, Chicago, are working a series of modern miracles. These men are not communists. They have little interest in the ideas of Marx, or the policies of Stalin, Lenin, or Trotzky. They are not interested in whether the Soviet flag is red, blue, or green. They are engineers, hired to do an almost impossible job in double-quick time, and they are doing it. They would do the same thing in Tibet, or Madagascar.

Across the River Dnieper, in the Ukraine, they are building a hydroelectric power dam that will harness more than twice the power Americans now are generating at Niagara. At the old annual fair city of Nijny Novgorod, they are building a huge automobile factory.

At a little place called Magnetogorsk, in the Urals, they are developing Soviet Russia's "Gary, Ind." the greatest iron

(*Continued on page 125*)





No wonder it attracts their attention. It is the first Ford car assembled at the Moscow automobile plant. In the near future parts for these cars will be made in Russia but at present they are all imported. At upper right, Russian workmen installing a motor in a car at the Moscow Ford plant.

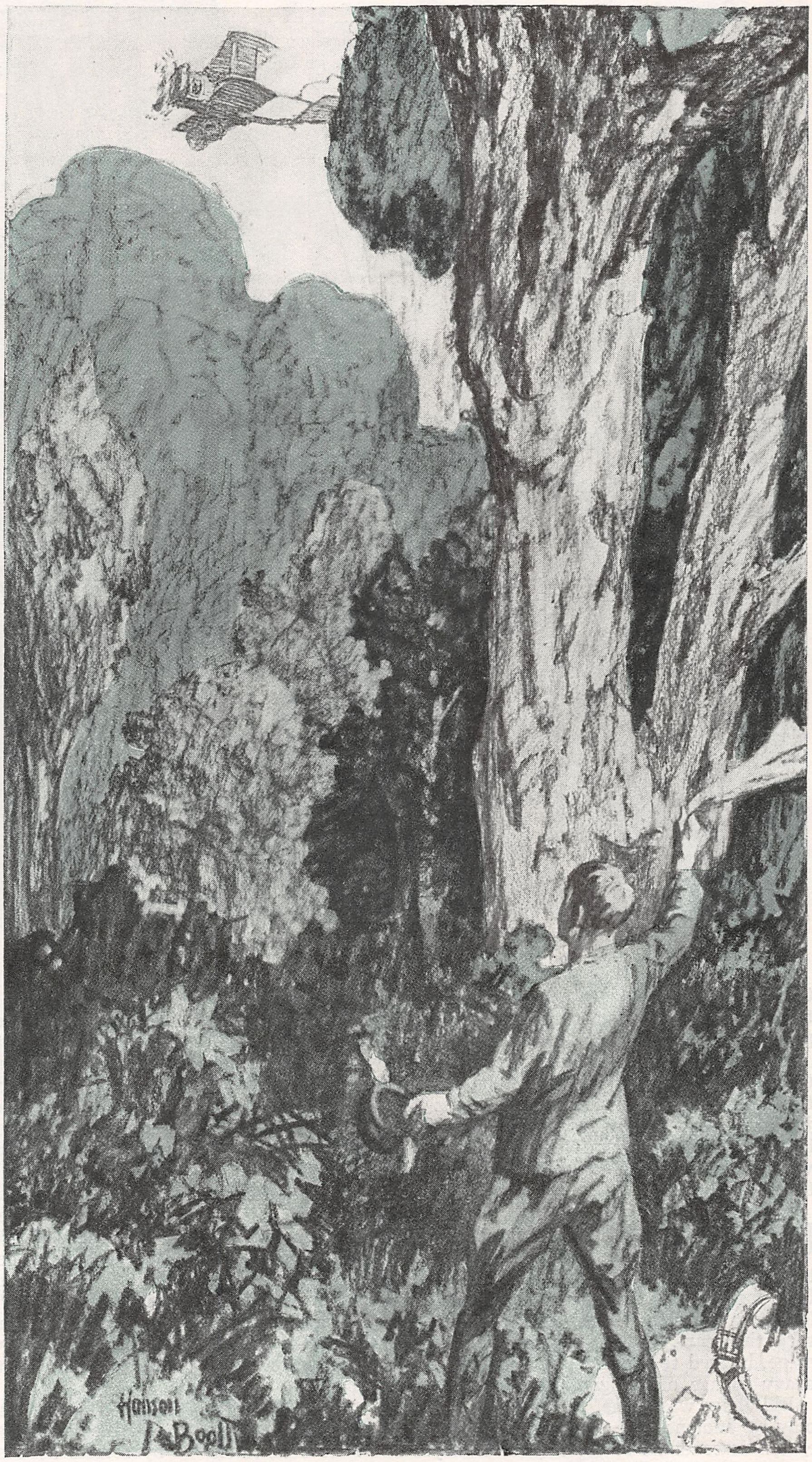
Air Hunt for Jungle Gold

This fact story of a brave flyer's quest for long lost treasure will thrill you with its romantic spirit of daring adventure—Using a parachute to land close to Mayan ruins, Captain Long defies the savage natives

By

IRA O. WELBORN

Illustrated by Hanson Booth



Long waved his scarf. The pilot saw him, tipped his wings, and vanished behind a tree.

BILL LONG tested the fastenings of his parachute, climbed to the wing of his speeding plane, and looked down. Behind him far to the north was Mexico City, an hour away was the little city of Tlataya, behind him the limpid Rio Mescala fought its tortuous way northwest to become the Rio de la Balsas in its leap to the gulf—and beneath him were the half distinguishable ruins of what had once been one of the fabled cities of the Mayas.

Tangled trees that tufted the ridge of the Sierra Madre del Sur all but hid the ruins. There was only a trace of the gigantic and fabulously wealthy city where the last of the Mayas had made their futile stand before the invading Aztecs hundreds of years ago.

No plane could land there and live. Bill Long took a deep breath. He waved a reassuring hand to the pilot and—leaped.

Treasure had lured Capt. Long, world war veteran, sportsman, and proprietor of a Dallas, Texas, flying school, to stake his life on his ability to get back to civilization from the abandoned city of the mystery people of the North American continent. In those ruins, on the most inaccessible spot of the whole lower Mexican peninsula, he hoped to find riches left in their shrines by the chiefs of that vanished race. Golden goblets. Temple gems. Probably the fabulous wealth of Montezuma who, before he was slain after the invasion of Cortes, buried the wealth of his Aztec tribe in a city that had been built by the Mayas he himself had conquered.

Once before, in 1926, Long and three companions had been near the spot and had found such treasures; but natives attacked them and killed two of the party. Only Long and Al Hargrave, of Hobbs, N. M., escaped to bring back the tale of the forgotten riches. Now alone Long ventured after the treasure.

The bundle of tools—the machete and pickax and double-bitted woodman's axe—snatched at Long's waist, where they were snapped by a cord. He jerked them loose and pulled the rip cord of his parachute. As it streamed out above him, he glimpsed his plane circling in a steep bank, with the pilot anxiously watching.

The heavy trees of the Sierra Madre slopes were leaping up toward him. His downward flight paused sharply as the parachute filled; he swung like a huge pendulum, watching the

Easing his hand to his automatic, Bill Long waited. Then he saw another and another of the gliding savages.

trees for an opening. Slipping between two mahogany trees and through a mass of underbrush, his feet hit the ground. His parachute twisted crazily above him in a tree.

From overhead came the drone of the plane. Scurrying through the tangled jungle went animals and possibly some of the savage natives. Around him was the half light of the jungle. Somewhere in the vicinity were his tools and his food—his only hope of even remaining alive—and somewhere in the vicinity were untold fortunes in gold and gems and archeological treasures.

UNSTRAPPING his parachute harness, Long beat his way through the brush to a little knoll, exposed to the sky. He took from his neck the light scarf that he wore as a protection from insects. He scanned the sky until the plane, now dropping low over the trees, searched for him. He waved great circles with the scarf. The pilot saw him, tipped the wings of the plane, banked to the north, and was lost from sight beyond the heavy foliage of a gigantic tree.

Bill Long was alone, the one white man in a land inhabited only by Indians—the unfriendly, reputedly cannibalistic, degenerated descendants of the slaves of Mayas and Aztecs centuries ago.

There were two things Bill Long had in mind. He planned, if possible, to clear a landing field sufficiently large to enable the plane to return for him in a week and land. A close scrutiny of the jungle at the foot of the mountain range from the air had blasted all but the barest chance of that. His alternative plan was to map the section so that a land expedition, trekking from an airplane base fifty miles north, could cut through the jungle and reach him.

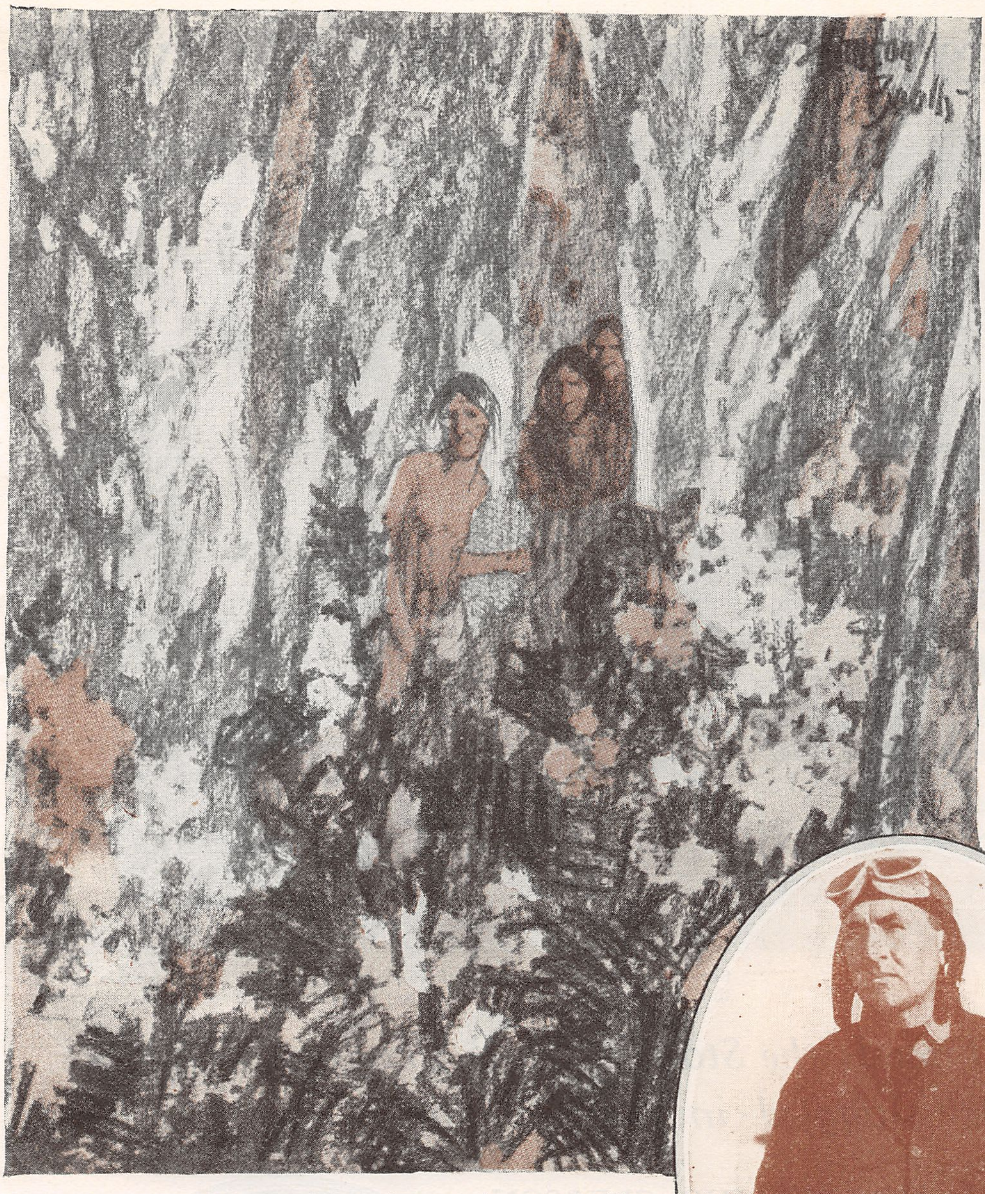
First, he found his tools. His camera was smashed to junk; his supply of food was badly damaged in the fall, but his medicine and first aid kit was intact.

A few hours' survey removed all hope of returning with an airplane. The treasure hunt was to be a fight of one man against the jungle. It was hopeless to think of clearing off land; a dozen men could not have made a landing field in a month. The tiny plateau which Long had noted four years ago was covered with a heavy growth that had sprung up, mushroomlike, since he visited the place.

His maps were carefully made—he had flown throughout Mexico for the Mexican government ten years ago when he was operating the "Southern Airways" out of Tampico. He had flown many thousands of miles over the trackless jungles of Morelos and Puebla and Oaxaca, and he had made detailed notations that could not be included by the earth-bound cartographers. He would map the location of the buried city, and the route he took to return to civilization.

NOW he was in the wildest jungles of Guerrero, banked on the southwest by the Sierra Madre and on the northeast by forests as dense and dangerous as the Amazonian wilds. Wilder than the untracked places of Yucatan, more nearly impenetrable than the fastnesses of Tabasco or Campeche. And peopled by he knew not what sort of natives.

There was one great advantage—a trump card that might have been played for him. That was the superstition of the natives, and the word that had been sent them by one of their deified personages, Dr. H. A. Monday, of Mexico City, who had helped Long plan the trip. Dr. Monday, an archeologist of note and one of the foremost authorities on the



As Long approached some of the natives ran. Some stood still.

Maya and Aztec culture, had received years before a small stone idol in return for making a trip far to the south of Mexico City to treat the chief of one of the tribes.

The old chief was suffering a painful but easily remediable illness; he was cured. Dr. Monday was considered a god. He treated other native tribesmen; he gained their confidence. And, bit by bit, he collected pieces of treasure from them, and a knowledge of the far greater treasure of archeological lore that was awaiting him who was hardy enough to get it.

DR. MONDAY had given his word to the natives over a period of two years that "some day I will come back like a bird. I will fall out of the sky, and you will know then that I want to see all the places where you get these treasures. Or I may send someone else, and he will drop out of the sky like an eagle. Remember: when you see some one drop out of the sky into your land, you will know I sent him, and you will all get very sick and die if you do not help him."

In the ancient Mayan polyglot of Cachiquel, Quiché, Zotzil, and Sutughil languages, the natives had assured their white god who made people well that they would remember.

"Pretty slim hope," Bill Long mumbled grimly to the shaggy trees on the grizzled slope that led up the hills. "My life depending on a fool superstition."

With his heavy machete, he hacked his way toward the bald spot of limestone that, from the air, marked the entrance to the buried city he sought. The natives had told Dr. Monday the cave "goes through the mountains so that one may go in on the side of the shadow (the northern slope) and come out on the side of the big water (the Pacific Ocean)." They also had told him that no one who had been through to the other side had ever returned, and that no native would go all the way. The doctor could go all the way, though; he was a god.

It was through the entrance to this cave which he had found four years before that Bill Long expected to find a buried city greater than the famous excavations of Uxmal, architectural ruins rarer than the monumental temples of Palenque or Coban or Chichen-Itza or Quirigua, all left by the Mayas.

ALTHOUGH his parachute had dropped within a quarter mile of the landmark, it took Long six hours to beat his way to the opening of the cavern. He found it covered with limestone and earth, and nearly overgrown with the heavy vegetation of the region. Whether the natives had for some reason sealed it up, or whether one of the common earthquakes had deposited a slide over it, he could not tell.

For two days he made observations, revising his maps, studying the needs of an expedition to unseal the mystery of the "mountain city." Then he struck north, away from the mountains, and toward Iguala, his airplane base. In seven days his plane was to return for him. If there was a landing field cleared at a designated place, it was to land. Otherwise the pilot was to know Long had taken to the jungles, in which no plane would land.

Cutting through the tangled creepers and small growth that makes travel almost impossible, Long came upon a trail. There were no tracks of animals; it was a native trail. Should he follow it to a village and perhaps be killed, as were his companions on the fatal venture of 1926? Or should he skirt it and attempt to make his way northwestward to Iguala, the little native village from which he had flown three days before? The question was decided for him.

Captain Bill Long—soldier, aviator, and golfer who is seeking lost Mayan treasure.

As he rested beneath a vine-hung tree, he saw a reddish-black body slip behind a tree fifty yards away. Easing his hand to his automatic pistol, he waited. Then he saw another, and another. He was watched. Now it all depended upon the attitude of the natives.

He stepped into the narrow, winding path. Putting his hands to his mouth, he halloed the Maya signal of greeting. Again he yelled, as if he thought he was alone in the forest. Then he walked toward the point where he had seen the natives. Some of them ran. Others stood their ground, menacingly. Long, with outstretched arms, walked slowly toward them. He tried, by sign language, to tell them he wanted to follow the trail to their village, where he could eat and sleep.

Walking behind him several paces, the natives permitted him to follow the trail. It soon came to a *(Continued on page 129)*

Wire Men Work Radio Marvels

Seventy-six stations, scattered throughout the entire United States, are getting this program which is being broadcast from the New York studio key station.

Here for the First Time Is the Story of How Thousands of Miles of Phone Lines Are Juggled in Each Nation-Wide Broadcast

By STERLING GLEASON

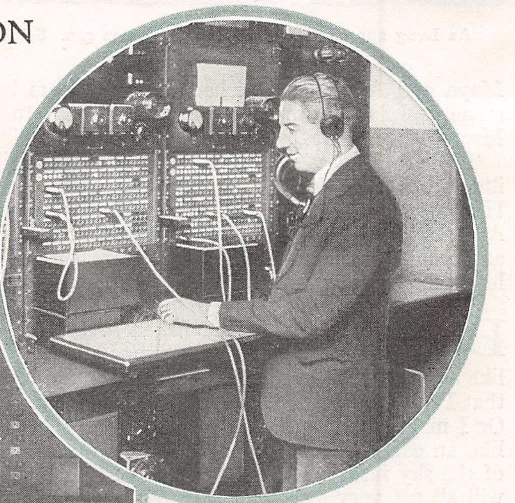
IT IS 9:40 o'clock on Christmas Eve. Singers and musicians arrive at one of the large studios of the National Broadcasting Company in New York City. At ten o'clock, a nation-wide network is to carry a program of Christmas carols from coast to coast.

In a shanty by a roadside in northern New Jersey a small boy is playing with a lighted candle. The taper drops from the boy's hands. Five minutes later, the shack is in flames.

At 9:45 telephone company and broadcasting engineers test the wire circuit. There is a break in New Jersey. In less time than it takes to tell here, the trouble is spotted. Flames from the blazing shanty have eaten their way through the long-distance telephone cable linking New York with Pittsburgh.

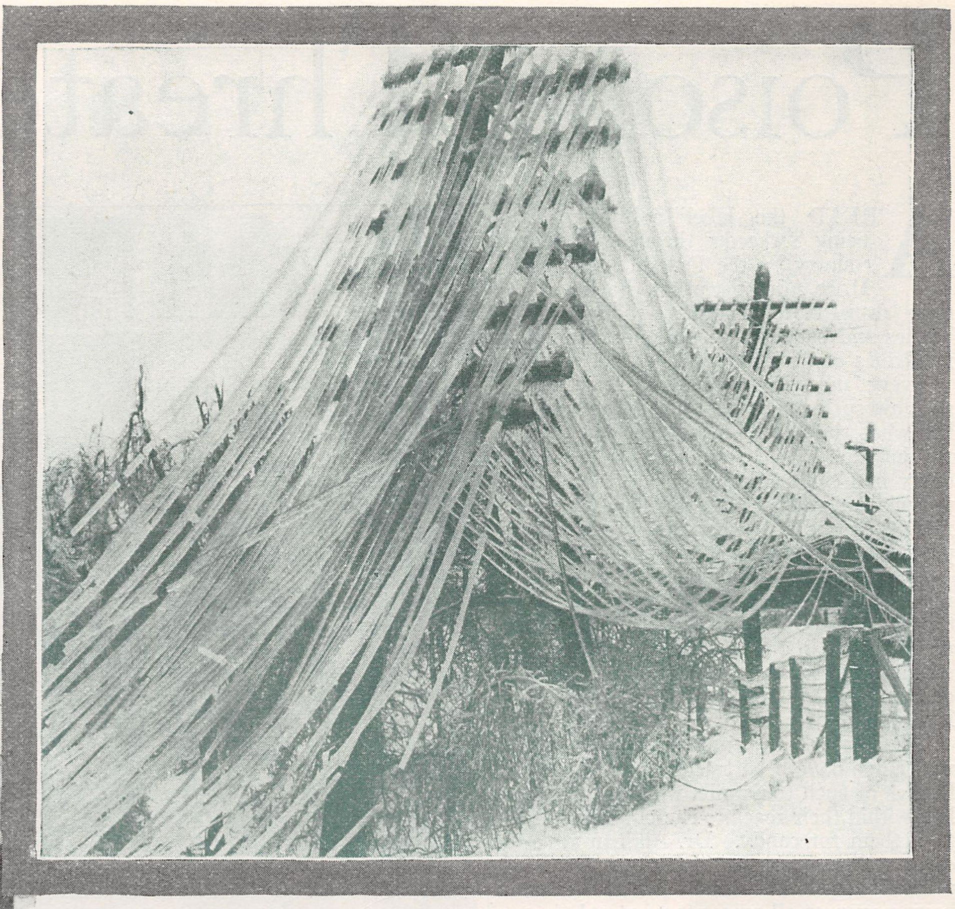
Forty linemen are sent out from the nearest telephone headquarters. They reach the scene at 9:50. Ten minutes to go. Four hundred fingers, forty pairs of pliers fly faster than the eye can follow them. Ten o'clock. The cable is respliced. The carols go on the air as scheduled.

Even if the linemen had not bridged the gap in double-quick time, the cheery old songs on that same program still would have rung from loudspeakers from New York



Above is the switchboard in American Telephone and Telegraph Co. headquarters, New York, that connects country-wide wire lines with the broadcasting studios.

At left, the transmission control room where most of the wires that make national hook-ups possible begin or end. The man standing at the left plugs in whole cities or sections as a telephone operator plugs in one call. The operator, front right, keeps in telegraphic touch with various repeater and terminal points.

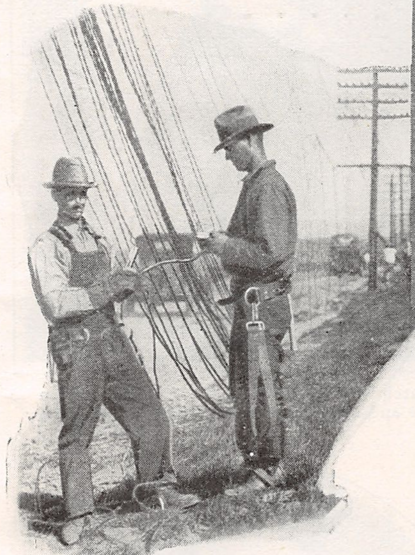


This is what gives work to the constantly active linemen. These New England wires are loaded with three inches of ice that drag them down but can't stop the broadcasting.

to San Francisco. In the dictionary of network broadcasting, there is no such word as "can't." By any one of a number of roundabout routes and a technique developed to the point of apparent magic, telephone engineers would have managed to bring you the carols.

Take a case that happened a few weeks before Christmas. While a nation-wide broadcast was being put on the air in New York, a severe storm was sweeping across the Middle West. Breaking with full fury near North Platte, Nebr., the blizzard howled across the prairie, twanging the taut lines of the long-distance circuits, and sheathing poles, cross arms, and insulators in ice.

Suddenly the wires, drawn to bowstring tension by their load of snow and sleet, parted. The central transcontinental line was down. And along the northern route, many miles of wire lay, a twisted ice-clad tangle, in a raging Montana blizzard.



Emergency repair men keep breaks from ending program.

Before the thousands of listeners realized that the program was being interrupted, operators knew what had happened. Technicians, seizing switchboard cords, plugged together new combinations of circuits. In an instant, another route was created. On sped the symphony music from New York to Chicago, to Kansas City, to El Paso, to Los Angeles, and north to San Francisco and Seattle!

THE program was interrupted for only a moment; yet for a couple of weeks, until crews of linemen could repair the damage, listeners in Denver, Colo., without knowing it, received their New York programs by way of a circuit coming *east* to them across the Rockies.

One morning at eight o'clock, a network program was to go out from New York through Chicago to Omaha, by way of Des Moines, Iowa. Fifteen minutes before broadcast time, the circuits were tested as usual. Everything was shipshape. At 7:55 telephone men received the flash: "Total failure between Des Moines and Omaha."

A CYCLONE had swooped down upon the region, tearing up miles of telephone poles. In a twinkling, engineers got busy. They rerouted the circuit from Chicago south to St. Louis and Kansas City and then north to Omaha. The new connection was ready at 7:59.5—four and a half minutes after receipt of the flash and one half minute before broadcast time.

Such magic is only part of the amazing technique of modern chain broadcasting, made possible by myriad scientific devices ranging from gas-filled cables that sound warning gongs when a break is impending to trouble-locating instruments that spot wire faults hundreds of miles away with incredible precision.

O. B. Hanson, center, manager of engineering operations of National Broadcasting Co., is checking the network circuit.

THIS entire development is less than four years old. In the early days of radio, there was only one method of broadcasting. A phonograph record was played, a soloist sang a song, or a speaker made an address in a studio, where the program also was put on the air. Then came remote control and, with it, the wire line. Someone realized that, if a microphone were put, say, in a New York theater and a telephone wire run from there to the studio, programs could be varied and greatly improved. At first, the length of these wires was only a few city blocks.

Meanwhile, the power of transmitters was increased, first to 1,000 and then to 5,000 watts. To get away from interference due to tall buildings and other steel structures, the broadcasting stations were moved some distance into the country. But the studios remained in the big cities. Again, the telephone came into play. The programs were, and still are, carried from studio to transmitter by wire. These lines, however, seldom are longer than fifty miles.

Since then, radio has grown rapidly from a novelty in entertainment into a huge, nation-wide

(Continued on page 136)

Poisons Threaten You

A "READ the label" campaign is being waged throughout the country by the Federal Food and Drug Administration. Each year, over drug store counters, millions of bottles and packages of poison-containing medicines are sold.

Every day, thousands of Americans swallow such preparations without knowing what they contain and without even reading the label to see. In practically every household medicine chest there are poisons, an overdose of which may prove fatal. According to experts, "there's no place like home—to get poisoned."

Dr. John Aikman, of Rochester, N. Y., recently pointed out, in an address before the Rochester Pediatric Society, a particular menace in this situation. Often, he said, sugar-coated tablets and pink pills, containing strychnine, are placed on the lower shelf of a medicine cabinet.

The deaths of a number of children under five have been traced to half-empty bottles of such tonic pills which had been left within their reach. The children mistook them for candy. Dr. Aikman advocates a law requiring "POISON" to be printed across the labels of all drugs having even small amounts of strychnine.

Besides this poison, many other deadly chemicals are used as ingredients of patent medicines that stock the shelves of household cabinets. Analysis of hundreds of nostrums reported by the American Medical Association and other organizations reveal the wide variety of active poisons they contain.

For example, a cough medicine had for two of its ingredients chloroform and sulphuric acid, the latter a burning, corrosive poison. A pneumonia preparation contained carbolic acid. A liver, stomach, and kidney remedy had in it arsenious acid, containing arsenic, and hydrochloric acid. "Consumption cures" contained nitric acid, arsenic, belladonna—the brain-affecting poison from the plant of the deadly nightshade—and strychnine, a poison that attacks the spinal cord.

COLD and grippe tablets contained acetanilid and aconite, powerful heart-depressing poisons. Liver pills had aloes, a virulent plant bane, in them. Nerve tonic contained potassium bromide, a poisonous sedative; laxative tablets, acetanilid; headache wafers, acetanilid, caffeine, and the two heart-depressing coal-tar drugs, antipyrine and phenacetine; cholera mixtures, opium, chloroform, ether, and alcohol.

Soothing and teething syrups put on the market for babies had as ingredients morphine, alcohol, heroin, chloroform, opium, and calomel, a form of the poisonous chloride of mercury.

While the law requires that such poisons be listed on the labels of the medicines, this means little to the average user who has no idea how large a dose of a given poison is safe. These poisons are often beneficial in small doses but fatal in larger quantities. Those who follow the reasoning that if one dose makes them feel better, two will cure them, are in serious danger.

Two years ago, a new brand of headache powders was put on the market. Each powder contained six grains of acetanilid, the heart depressant which is an ingredient in practically all headache remedies. It slows down the heart action and thus reduces

When taking a remedy out of the medicine chest watch what you are doing. If your attention is distracted, you may easily seize the wrong bottle and swallow poison instead of medicine.

In Government laboratories, chemists work to guard the public against poisons and impurities. In circle, child chewing painted toy may be poisoned by lead in the paint.

at Home

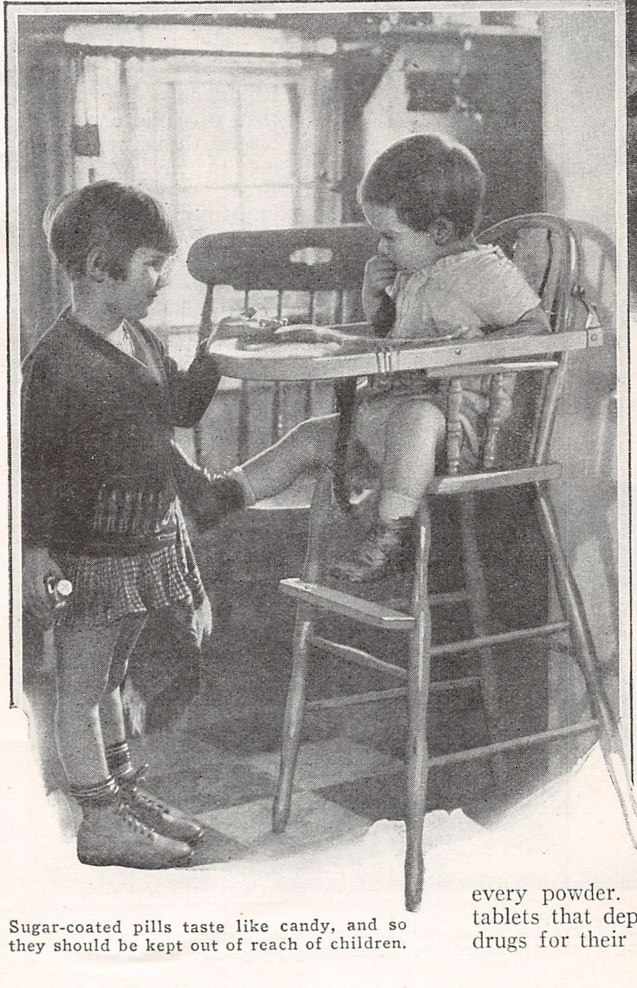
Common Cures Contain Dangerous Chemicals and Carelessness in Their Use Is Blamed for Deaths—Read Labels, Warns Government

By EDWIN W. TEALE

the throbbing pain in the head of the sufferer. The usual dose is three grains. A woman in a New England city, in her anxiety to recover, took two of these double-strength powders, instead of one, with fatal results.

On the label of the powders the amount of acetanilid they contained was printed. So the company making them was not liable under the Pure Food and Drug laws. These Federal statutes do not regulate the amount of poison a medicine can contain. They require only that the actual amount be printed on the label. If too much of a deadly drug is included and a fatality results, civil suit can be instituted against the company by relatives of the deceased. Consequently, the usual practice of manufacturers is to put in too little of a dangerous ingredient rather than too much. They would rather not cure than kill.

Besides putting the correct amount of poison on the label, the manufacturer is required by the Pure Food laws not to print any misleading statement about his product. He cannot label a poison-containing concoction: "Harmless." But, while he is required to tell the truth, he is not required to tell the whole truth. He does not have to label it: "Poisonous."



Sugar-coated pills taste like candy, and so they should be kept out of reach of children.

Most of the activity of the Food and Drug Administration in relation to poison-containing drugs concerns misbranding. Not long ago, calcium wafers containing strychnine were widely advertised simply as "Calcium Wafers." A large quantity of the product was confiscated and destroyed by Federal agents because the branding gave the false impression that the wafers contained nothing but calcium.

Though the druggist selling you headache powder calls your attention to the label that gives the ingredients, how often do you read what it says and thus guard against an overdose?

In another case, a quantity of "harmless headache powders" were destroyed because they were labeled: "Does not contain a poisonous drug," when they actually had five grains of acetanilid in every powder. Headache and anti-pain tablets that depend upon coal tar poison drugs for their effectiveness "depress the heart, injure the blood, and produce a habit," it is pointed out. Again, the makers of a bromo-aspirin product were charged with misbranding when they labeled their product: "Each tablet contains one grain of acetanilid," when it actually contained more than one grain.

A few weeks ago, a wholesale drug concern in New England was fined $500 for misbranding two poisons, digitalis and nux vomica. The Government officials proved that the digitalis was only one half as strong as the label indicated, but that the nux vomica, a deadly strychnine poison that produces suffocation and has caused death in five minutes, was almost twice as strong as the label stated. If it had been used on the basis of its label, fatalities might have resulted.

Only an extraordinary twist of fate prevented a tragedy last fall in Washington, D. C., when a bottle of lethal aconite was sold under a wrong label. The Pure Food and Drug Administration sent to a drug store for bottles of several drugs to analyze in its laboratory. One bottle was marked "Tincture of Aconite," another "Tincture of Digitalis."

When chemists made their tests, they discovered that a clerk had mixed the labels and that the strong aconite was in the bottle marked "digitalis." If it had gone into a family medicine chest, instead of, by rare good fortune, into the testing laboratory, it would have carried death with it.

Since the Pure Food and Drug Act went into effect, in 1907, the Government has instituted more than 17,000 seizures and prosecutions in its program of insuring the correct branding of drugs. But as long as the maker of a medicine places the correct amount of the dangerous elements in it on the label, there is comparatively little interference with the ingredients he chooses to use.

And there is no restriction upon who can concoct patent nostrums. A doctor or a druggist must have specialized training and a certificate attesting to his competence, but no training, either medical or pharmaceutical, is demanded of the manufacturer of patent drugs. A mason who wants to lay down his trowel, or a farmer who becomes tired of his plow, can begin mixing drugs and poisons together and selling them to people who are dangerously ill!

Some years ago, a blacksmith set himself up as an expert on kidney and bladder

(Continued on page 134)

Hard Work Made Me a Flyer at *Sixteen*

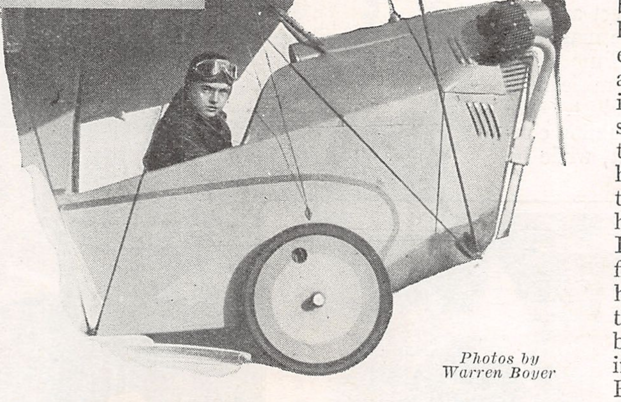
America's boy aviator tells you in this thrilling article how he rode with Lindbergh, won three licenses, and set altitude record

By PAUL CLOUGH

At sixteen Paul Clough is a licensed pilot, an American altitude record to his credit.

WHEN I was in the eighth grade, four years ago, I had my first close-up view of an airplane. A friend and I rode our bicycles to Roosevelt Field, Long Island, after school. As I watched the ships take off and land, the "flying bug" bit me hard. All other interests faded away. I forgot about baseball and the workshop in my cellar. The instant school was over, I jumped on my bike and raced for the field. And I stayed there until the planes were put away for the night, and many a time I got home late for supper.

I knew I was going to fly some day. But I had no idea I would have the good fortune to ride with Lindbergh, make a solo flight after three and a half hours instruction, obtain three pilot's licenses, and establish an official American altitude record before I got to be a junior in high school!



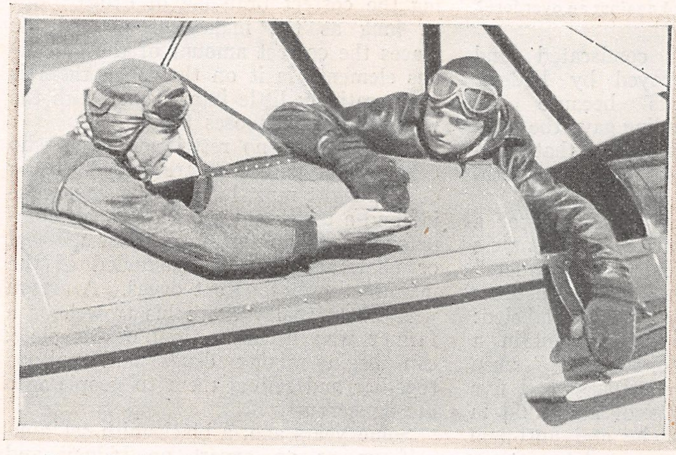
Photos by Warren Boyer

In the cockpit of the "flying bathtub," the little Aeronca plane Paul flew to 10,525 feet.

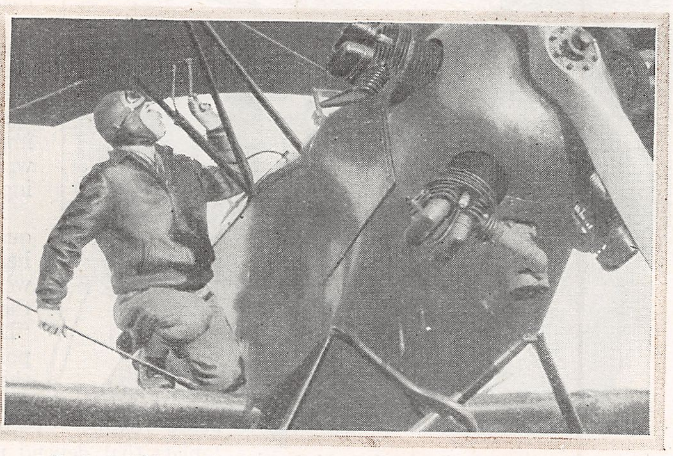
That first visit to Roosevelt Field took place about three weeks before Charles A. Lindbergh landed on his flight from San Diego in the *Spirit of St. Louis*. I saw him come in. But I missed the take-off for Paris. It was made early in the morning while I was home in bed and fast asleep.

The hangar I haunted most at the field belonged to the Fairchild Company. The mechanics used to let me wipe oil and mud off the wings of the big yellow monoplanes, hand them tools, and run errands. I made myself as useful as possible and in return they answered some of the million questions I asked. If they had stopped to answer them all, they would have had time for nothing else. I read everything about flying I could lay my hands on. The articles that gave me one of the biggest thrills was "Learning to Fly with Larry Brent," which I read in POPULAR SCIENCE MONTHLY just as fast as the magazine came out.

I had been appearing at the hangar every day for six weeks when Dick Pears, one of the Fairchild pilots who is now flying mail between Kalamazoo and Bay City, Mich., gave me my first ride in the air. We were up ten minutes, reached 2,000 feet, and made 120 miles an hour. I got all out of wind pedaling home as



Randy Enslow, left, in a Standard biplane is giving Paul Clough last minute pointers about the "bombing" they have planned.



Early in his experience at the airport Paul learned to take nothing for granted, so here he is examining a gage on a school plane.

More and more as planes are developed and transportation leaves the ground, American boys and girls will seek careers in the air. How they can best learn this business and at what age to start are told in this article by the amazing boy who at sixteen is a licensed pilot. You fathers and mothers should read what young Clough has to say, that you may know what to expect when your children also take to the air.
—The Editor.

fast as I could to tell the folks the exciting news.

When I announced I was going to learn to fly, there weren't any cheers at home. Mother thought it was too dangerous and Father tried to discourage me by saying I would have to pay all the expenses myself. When you are thirteen, several hundred dollars seems a lot of money. But I said: "All right," and began saving every cent I could get for a "flying fund." The youngest that anybody can get a pilot's license is sixteen. So I had three years to save.

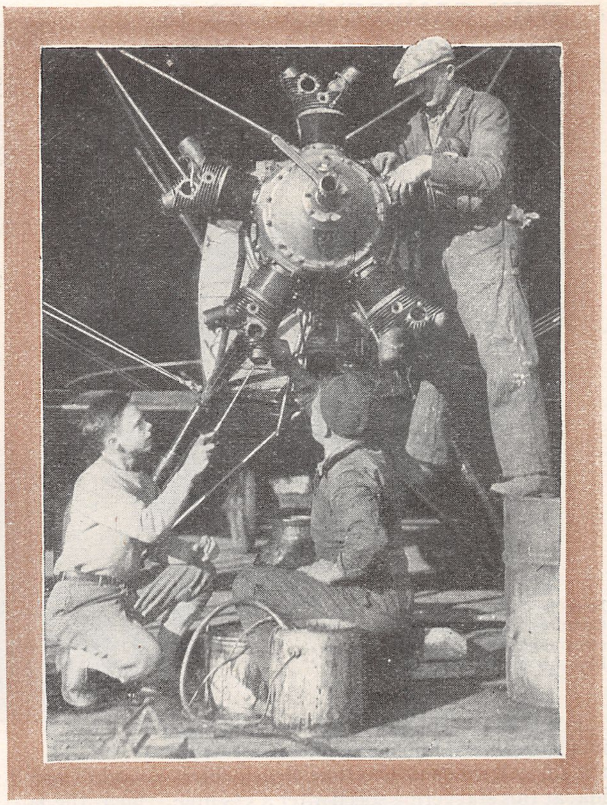
A few months after this, I had another ride that made me the envy of all the kids I knew. It was with Colonel Charles A. Lindbergh. Soon after the end of his "Good Will Tour" he visited Roosevelt Field to try out a new Fairchild-Wasp cabin plane.

One of the pilots at the field told him about me and said I was so interested in aviation that they couldn't keep me from underfoot. "Lindy" asked me to go along. We were up for twenty minutes and landed in a rainstorm. I "walked on air" for a week afterwards.

Other famous pilots who gave me rides were Martin Jensen, who flew the *Aloha* from California to Hawaii; Randy Enslow, known to all Popular Science Monthly readers, and Capt. C. B. D. Collyer, who piloted *The City of New York* around the world with John Henry Mears in 1928.

Collyer gave me my first cross-country experience, taking me along on a flight to Hadley Field, N. J., fifty miles away. We flew in bright sunshine above rolling white clouds that looked like hills covered with snow. On another cross-country trip with Everett "Chan" Chandler, one of the Roosevelt pilots, we flew under a low ceiling of clouds above Long Island. Once we roared just above a poultry farm, going 100 miles an hour. The chickens ran for dear life. I had a glimpse of half a dozen of them trying to get in a hole in a coop just big enough for one. They had their heads inside and were kicking and pushing, all trying to get in at once.

On every flight I learned something. I began keeping a log book in which I entered each flight, giving the date, pilot, plane, and time in the air. Before I had saved enough money to begin my flying course, I had had one hundred hours in the air as passenger; more than fifty pilots had taken me up, and I had ridden in two dozen different types of planes. The fact that I weigh only a little over one hundred pounds and can be tucked in almost anywhere helped get me free rides.


Paul's work at the field wasn't all just clean fun. Here he is helping mechanics overhaul an engine, learning as he works.

Dick Pears, after my first ride, warned me against going up with a pilot I didn't know. He gave me some simple rules for picking a safe pilot and plane which may help others. They were:

Don't go up with students who have just recently won their pilot's licenses.

Don't go up with old pilots who have not flown for a long time. Practice is needed to keep a pilot a safe flyer.

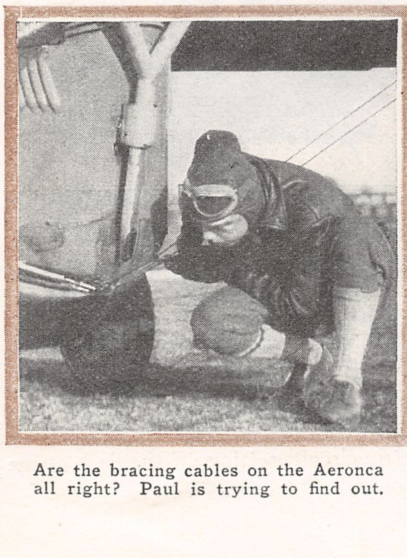
Army-trained flyers are among the best, but any pilot with 1,000 hours in the air and several years experience is a safe bet. As to planes:

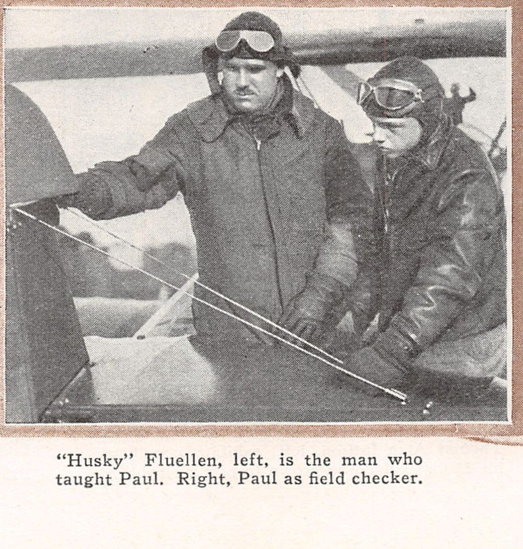
See that the registration number has the letter "C" before it. This indicates the craft is licensed to carry passengers. Planes with numerals only are merely registered and are not licensed.

Avoid planes of an obsolete type and ships that are left out in all kinds of weather.

The simplest rule to follow is to ride in planes operated by a carefully-managed airport. Here the ships are given expert care and pilots are thoroughly investigated before they

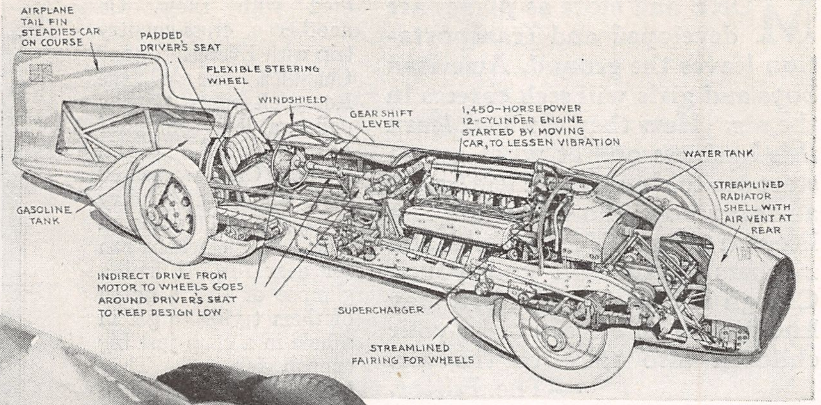
(*Continued on page 139*)

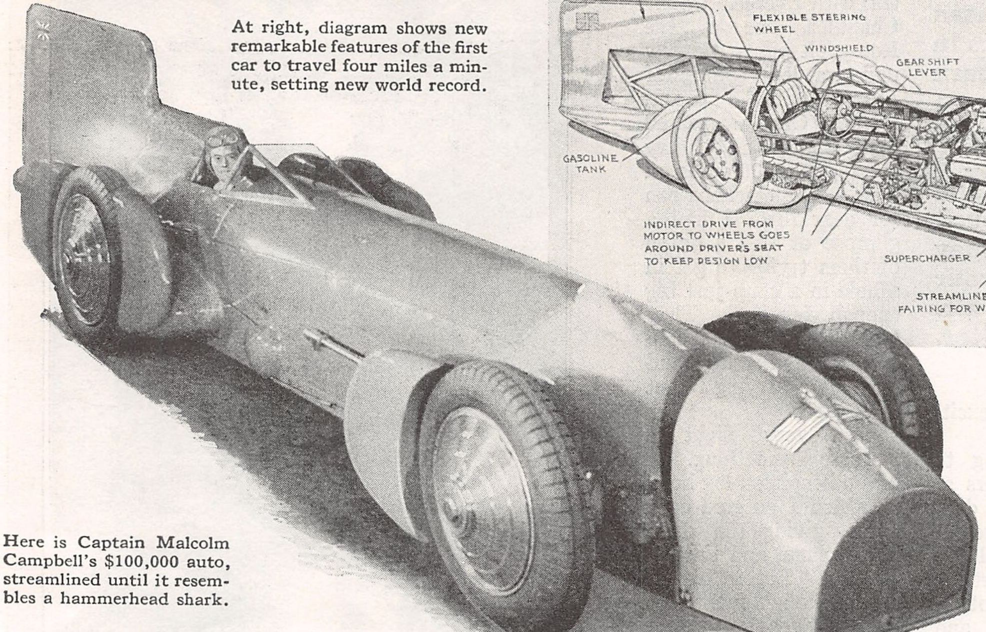

Are the bracing cables on the Aeronca all right? Paul is trying to find out.


"Husky" Fluellen, left, is the man who taught Paul. Right, Paul as field checker.

WHY CAMPBELL'S CAR IS THE WORLD'S FASTEST

At right, diagram shows new remarkable features of the first car to travel four miles a minute, setting new world record.


AIRPLANE TAIL FIN STEADIES CAR ON COURSE
PADDED DRIVER'S SEAT
FLEXIBLE STEERING WHEEL
WINDSHIELD
GEAR SHIFT LEVER
1,450-HORSEPOWER 12-CYLINDER ENGINE STARTED BY MOVING CAR, TO LESSEN VIBRATION
WATER TANK
STREAMLINED RADIATOR SHELL WITH AIR VENT AT REAR
GASOLINE TANK
INDIRECT DRIVE FROM MOTOR TO WHEELS GOES AROUND DRIVER'S SEAT TO KEEP DESIGN LOW
SUPERCHARGER
STREAMLINED FAIRING FOR WHEELS



Here is Captain Malcolm Campbell's $100,000 auto, streamlined until it resembles a hammerhead shark.

FOUR miles a minute! For the first time in history an automobile recently shot down the smooth sands of Daytona Beach, Florida, at this staggering speed after a 5½ mile running start.

The car was Capt. Malcolm Campbell's arrow-shaped *Bluebird II*, and its official record a shade over 245 miles an hour, the average of two successive runs. The British speed king, famed as a world war aviator and later as a racing auto driver, surpassed by fourteen miles the 231-mile-an-hour world's speed record of one of his countrymen, the late Sir Henry Segrave.

Just how Campbell's aluminum-sheathed car with its grotesque tail fin was able to smash a mark of two years' standing is explained by the diagram on this page. Terrific power, supercharged motor, and streamlining of the most radical type were mainly responsible, plus, of course, the British ace's cool courage.

Superchargers like those used on airplanes pumped air and fuel into the cylinders of the racing engine. Its 1,450 horsepower surpassed nearly by half the power of Segrave's 1,000-horsepower *Golden Arrow* in which he made the previous record.

The most controversial feature, the detached radiator shell, proved an enormous aid in cutting down the wind resistance. In addition, the drive shaft connecting motor and wheels was looped around the driver's seat so that the car's body hung only three inches from the ground.

Campbell had no competition at Daytona. The only possible American competitor, a 48-cylinder, 4,800-horsepower machine being built in California by Peter de Paolo and Harlan Fengler, noted American race drivers (P.S.M., Dec., '30, p. 72), will not be completed in time to race this year.

EDISON GROWS TWELVE-FOOT GOLDENROD

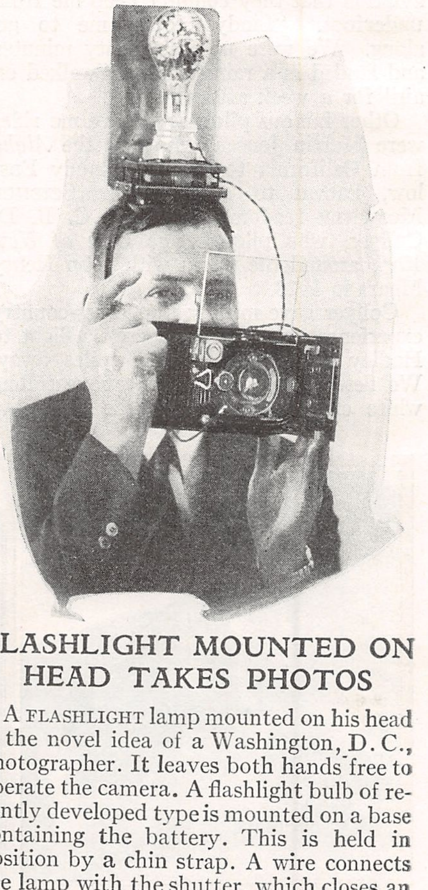
GOLDENROD twelve feet high is a plant wonder recently exhibited by Thomas Alva Edison, famous electrical wizard. It is one of the byproducts of his recent experiments at Fort Myers, Fla., in search of a domestic plant from which rubber can be extracted in commercial quantities. With this goal in mind, Edison has been raising and cross-breeding thousands of plants within the last few years on his experimental station at Fort Myers. The twelve-foot goldenrod is one of the results.

Other promising shrubs have been developed, especially those of the milkweed family, in the rubber hunt. Great possibilities are held out for the guayale plant, a weed that grows wild in Mexico and has recently been cultivated for rubber on a commercial scale in the western United States.

Thomas Alva Edison, left, exhibits a stalk of his 12-foot goldenrod grown to produce rubber.

RUGS TO HEAT HOME

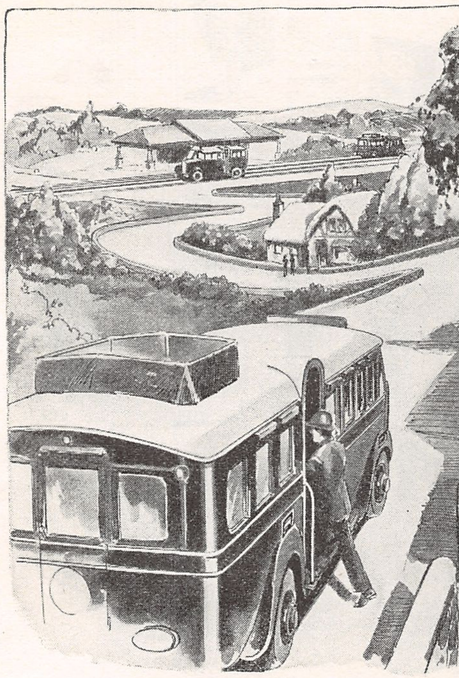
HEATING homes by rugs, according to some building experts, soon may be accomplished. They feel that advances in the field of electric heating will eventually displace steam, water, or vapor radiators now in use. When this occurs they suggest that a development of the electric pad, decorated like present rugs, and of varying sizes, may be employed to heat homes.



FLASHLIGHT MOUNTED ON HEAD TAKES PHOTOS

A FLASHLIGHT lamp mounted on his head is the novel idea of a Washington, D. C., photographer. It leaves both hands free to operate the camera. A flashlight bulb of recently developed type is mounted on a base containing the battery. This is held in position by a chin strap. A wire connects the lamp with the shutter, which closes an electric circuit, setting off the flash at the instant the shutter opens.

English Railway Car Calls for Passengers at Home



Drawing suggests how the ro-railer, being tried in England, will pick up a commuter at his door and deliver him at his office in city.

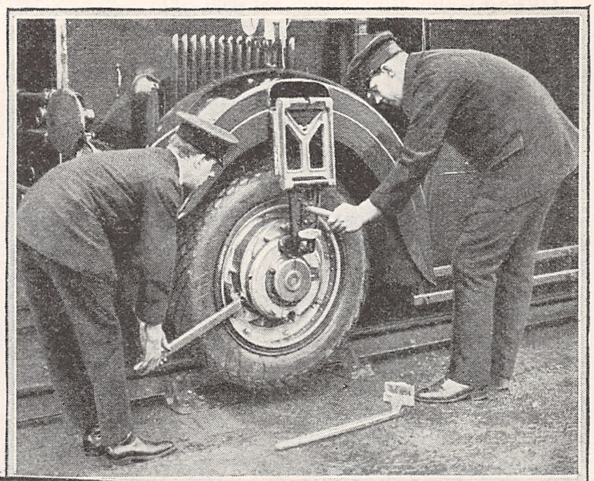
Suburban dwellers may no longer need, one of these days, to make long walks to the railroad station to take the morning train to business in the city.

An amazing vehicle tried out recently by an English railway calls for passengers at their own doorsteps, climbs on the tracks at the railway station for the trip to the city, and then dismounts from the tracks, delivering the passengers at their business places.

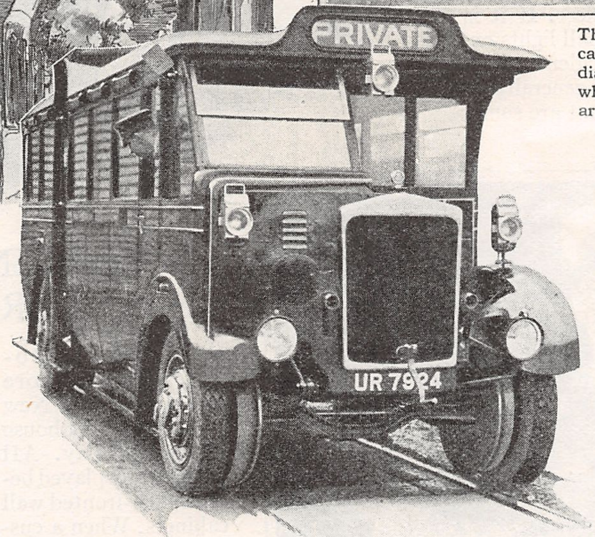
Dubbed the "Ro-Railer," the first of the new vehicles is a twenty-six passenger affair. Its 120-horsepower gasoline motor gives fifty-mile speed. Its general outline resembles an auto bus, but glass-enclosed driver's cab and double sets of wheels are conspicuous features.

When the car reaches the tracks, it is driven forward until the inner, flanged wheels come in contact with the rails. Then the road wheels are drawn up and locked.

Increasing competition of buses has led the London, Midland and Scottish Railway to experiment with the "ro-railer," on the portion of its line between Redbourn and Hemel Hempstead.



The road wheels are locked concentrically to the rail wheels which, of smaller diameter, clear the road. When flanged wheels engage with rails road wheels are lifted out of the way and fastened.



The ro-railer is run onto the rail at any point where the road is level with the track. Flanged inner wheels catch the rails.

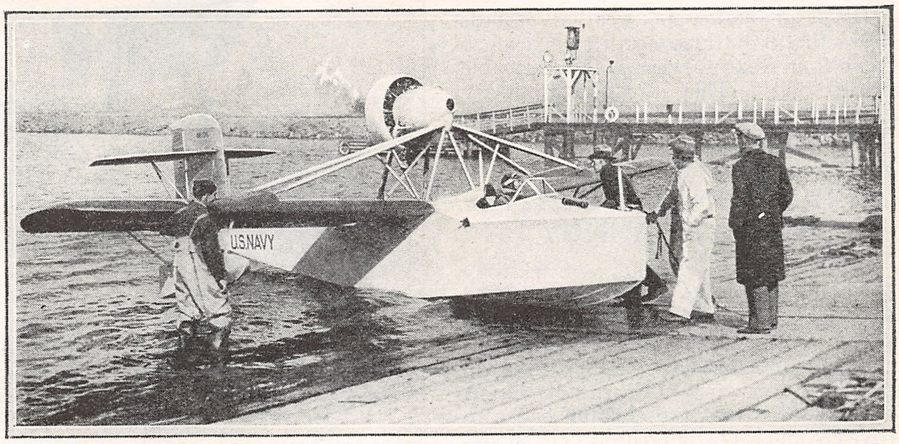
NOISE CAUSES BAD EYES

City dwellers may not be able to see as well as their country cousins on account of loud street noises. Recent investigations in Russia by Professor P. P. Lazarev and Doctor L. Kuper, show that loud noises narrow the field of vision of many persons. This would seem to indicate a reason for the many people found in cities who wear glasses when reading, since they travel to and from their work on roaring subway and elevated trains.

NEW FOLDING PLANE FOR SUBMARINES

Substantial and permanent seems the rigging of this new Navy seaplane, recently tested near New York City. Yet it folds up into so small a bundle that it can be stored in an eight-foot tube. The Navy's latest "mystery ship" is designed to be carried aboard a submarine, with its tubular, watertight "hangar" clamped to the upper deck of the undersea craft. Details of the novel craft's design are a military secret.

This is not the first time that the Navy has tested folding planes for submersibles (P.S.M., Dec., '26, p. 24). The newest model, however, designed by Grover Loening, is different from the others, having a pusher power plant raised above splashing waves, making the folding feature doubly ingenious because of its difficulty.



This is the new submarine plane of the United States Navy. Details of its design are military secrets, but it is known that it can be folded to go into an eight-foot tube.

WHEN YOU SEE STARS TWINKLE—THEY DON'T

Have you seen a star twinkle? Then you were seeing an optical illusion, according to Dr. John A. Anderson, of the Mt. Wilson Observatory in California. Actually stars do not twinkle.

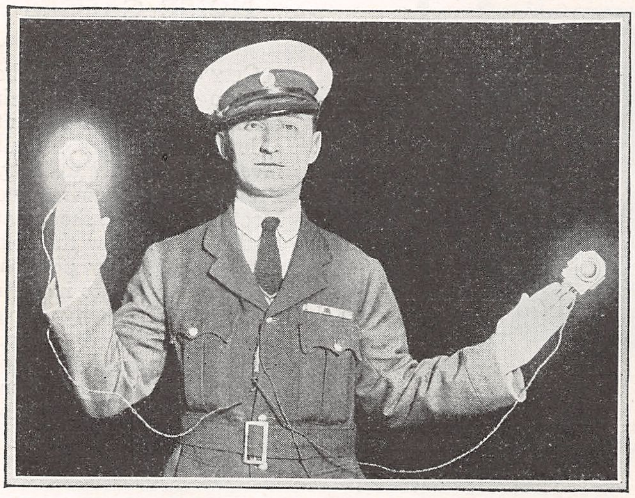
Tiny vortexes or whirlpools, only a few feet in length, in the higher parts of the earth's atmosphere are responsible for the apparent twinkling, he declares. They interrupt the beams of starlight as they drift across the path of its rays.

Astronomers of Mt. Wilson Observatory are building an instrument that will enable them to gage the height of the "air whirlpools" that make the stars twinkle.

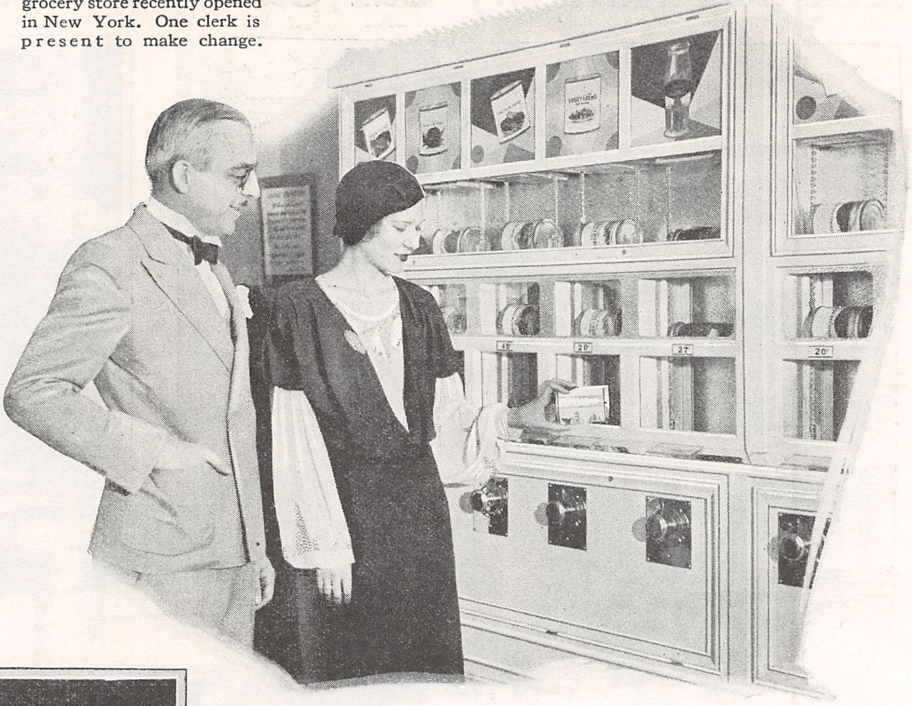
LIGHT IN EACH HAND AIDS TRAFFIC OFFICER

HUMAN traffic towers may be seen soon in some country districts in England, where permanent stop and go lights for motorists have not yet been installed. Mitford B. Hitchman, of Derbyshire, has invented a set of red and green hand traffic lights for night use. One is strapped to either of the traffic officer's hands. As he raises his arm for the stop or go signal the lights flash on. When the roads are clear in both directions and he drops his hands they automatically go out.

A small dry battery supplies current for the lights, which can be seen for half a mile on a clear night. The device is being tried out in several country districts in England by the Royal Auto Club. The intention, of course, is to use the hand signals at poorly lighted road intersections when the motorist, under ordinary circumstances, would have difficulty seeing the officer. If it is found that the use of these small lights expedite traffic and reduce accidents, it is likely that they will be used generally to supplement overhead lights that are sometimes hard to see.



Dry batteries light the red and green lamps in officer's hands as he gives signals to traffic.



Dropping a coin in the slot gets the shopper the desired product in this automatic grocery store recently opened in New York. One clerk is present to make change.

COIN-IN-SLOT GROCERY STORE RUNS ITSELF

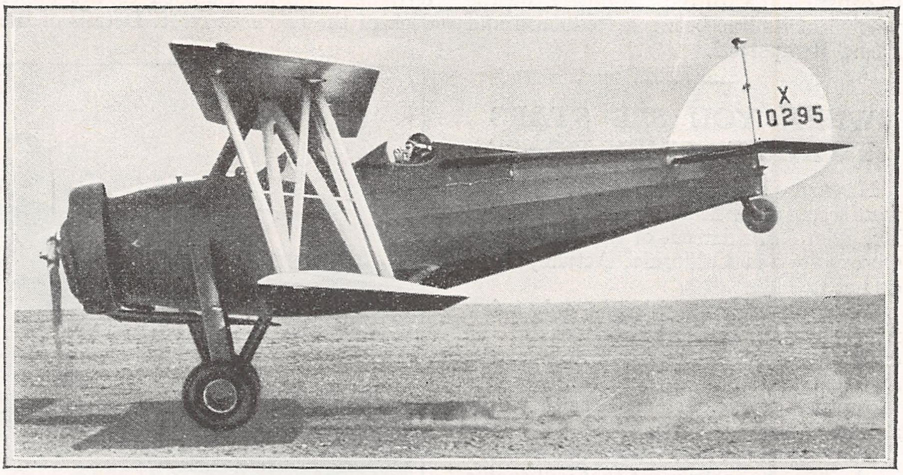
A NOVEL "automat" grocery store was opened in a New York apartment house the other day. All goods are displayed behind glass-fronted wall cabinets. When a customer drops the proper coin in a slot, a can of beans or a tin of peaches or maybe tomatoes rolls out. Only one clerk is in attendance to make change for the buyers. A meat and dairy products department of this shop works in the same manner. When a tin or package of food is bought from one cabinet, a chain conveyor automatically puts another one in its place. Shoppers find the "automat" store saves their time, since there is no waiting for a clerk, and delivery of the purchase, ready to be carried away, is made immediately.

NEW PLANE LANDS WITHOUT PILOT'S AID

HENRY WHITE, test pilot, waved his hands aloft as he grounded a plane the other day at Glenn Curtiss Airport, North Beach, N. Y. Without a hand on the controls the plane made a perfect landing.

This new three-passenger safety plane is the invention of Albert Adams Merrill, White Plains, N. Y., accountant and aerial experimenter. It comes to earth automatically at the proper angle and speed.

When he wants to come down, the pilot turns a handwheel that revolves both wings to an increased tilt or "angle of attack." Then he cuts off the motor.



This foolproof plane is designed to take the danger out of landing. Note that the test pilot, Henry White, is holding his hands up to prove that he is not touching controls.

MARCH HAS A FAULT THAT MEANS COLDER

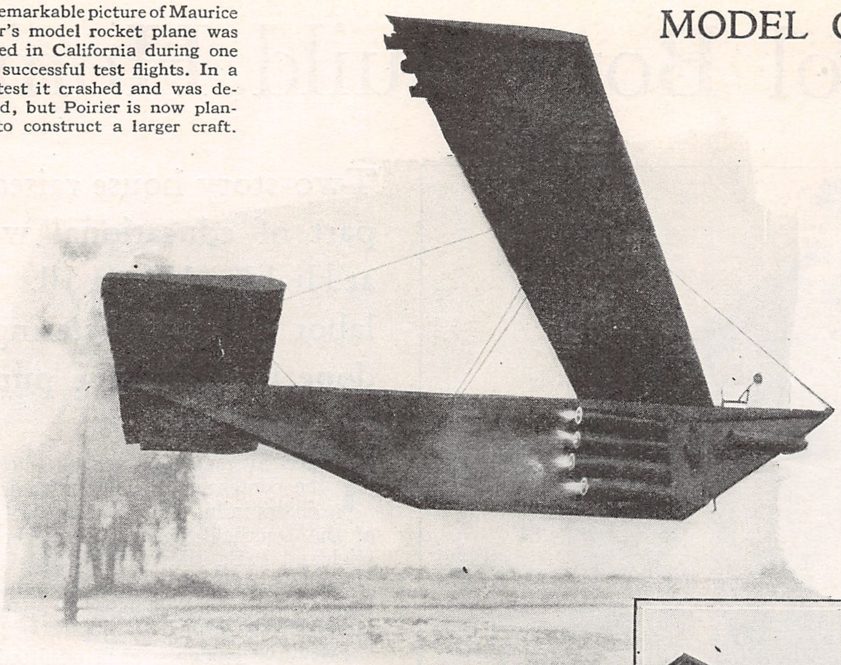
IF CHILLY March winds follow February's gradually rising temperature, don't lose hope of an early summer, according to Dr. James H. Scarr, New York City's official weather man.

His examination of weather records shows that only three weather phenomena recur from year to year with reasonable predictability. They are the "January thaw," the "Thanksgiving freeze," and the "March fault."

CHILDREN HAVE 2,124 WAYS TO ANNOY

WHEN thirty-two parents were asked by Dr. Mandel Sherman, director of the Child Research Center, Washington, D. C., to keep a record of the ways in which their children annoyed them, they turned in voluminous notebooks filled with entries. A count showed that the children had contrived to find 2,124 different ways of annoyance, each in practically universal use.

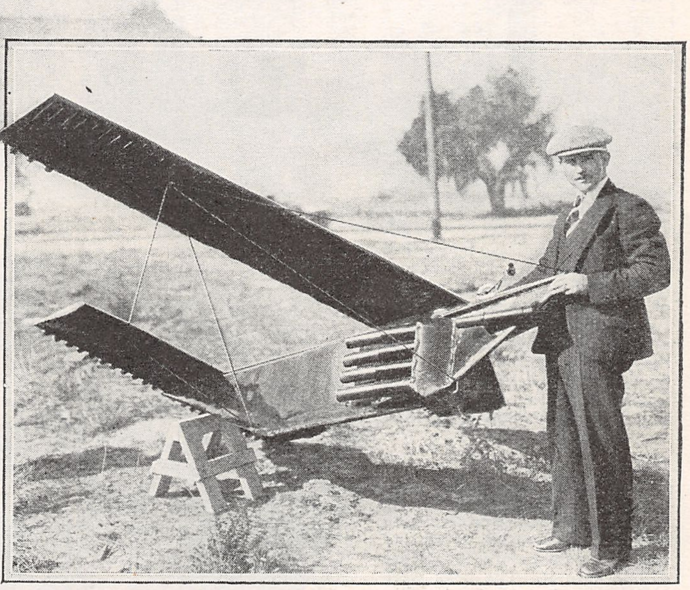
MODEL OF ROCKET-DRIVEN PLANE FLIES IN TEST



This remarkable picture of Maurice Poirier's model rocket plane was snapped in California during one of its successful test flights. In a later test it crashed and was destroyed, but Poirier is now planning to construct a larger craft.

MANY inventors dream of rocket airplanes, but few build or fly anything resembling them. An exception was Maurice Poirier, of Burbank, Calif., who started work on a model several months ago (P. S. M., Dec. 30, p. 56). He recently fitted a ten-foot model of his craft with an imposing battery of rockets and flew it repeatedly in successful trials. Finally, in a public demonstration, Poirier saw it crash at the bottom of San Francisquito Canyon.

Despite this setback, Poirier visions a larger craft of twenty-five-foot wing spread, able to carry a man, and propelled by liquid rockets. The secret liquid ingredients, he declares, are extracted from weeds obtainable only in Europe. Eighty-two rocket nozzles would give the ship terrific speed.

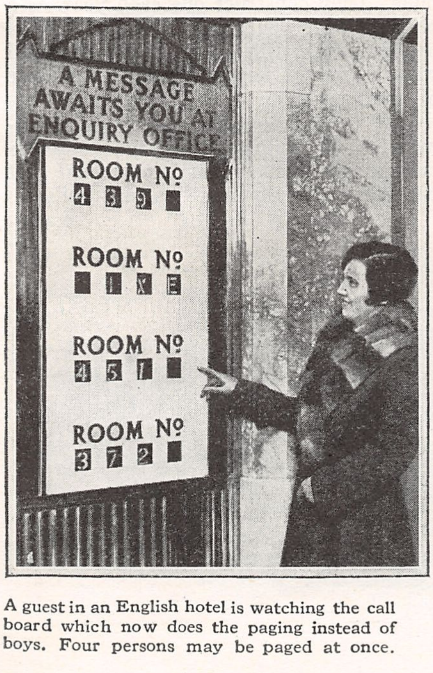


At right, Maurice Poirier, of Burbank, Cal., with his model rocket-driven airplane. His next machine is to be big enough to take a man up on its flights.

ELECTRIC LIGHTS PAGE GUESTS IN HOTEL

GUESTS at a new hotel recently opened in London, England, are paged by their room numbers instead of by name. They do not, however, hear a bell boy rushing through the lobby, shouting for them. Instead, an electric indicator on a wall of each public room flashes their number. A notice above the indicator box states that there is a message waiting for them at the enquiry office.

Four sets of numbers can be flashed by each indicator, so four guests can be paged at one time. Guests, it is said, find this system an improvement over the old method of paging by bell boys, since the latter often mispronounced their names so that they were unrecognizable. The lights come on in each of the public rooms simultaneously, so a guest has no excuse for missing a call, provided he can remember his room number and sees the signal.



A guest in an English hotel is watching the call board which now does the paging instead of boys. Four persons may be paged at once.

KITES USED AS RADIO TOWERS IN TRANSMISSION TESTS

KITES serve the purpose of radio towers for experimenters at the radio research station, Slough, England. When they set out recently to find the causes of erratic radio transmission in different localities and at various hours of the day, it ordinarily would have been necessary to erect a radio transmitting mast at each point of test.

Instead, the experimenters send aloft a kite with an ingenious transmitter weighing little more than a pound. Eight dry cells furnish current for its single tube. A hundred feet of aerial wire dangles from the kite. The automatic signals may be picked up at a distance of half a mile in receivers on the ground. At the end of its tether, the kite transmitter soars to a height of 500 feet above the earth. It is shown being "landed" in the photo at left.

Radio experimenters at Slough, England, are using kites as towers in the tests they are making as to cause of erratic transmission in various localities and at different times of the day.

High School Boys Build Home

Two-story house raised as part of educational work at Highland Park, Ill. All labor except plastering is done by fifty-five pupils.

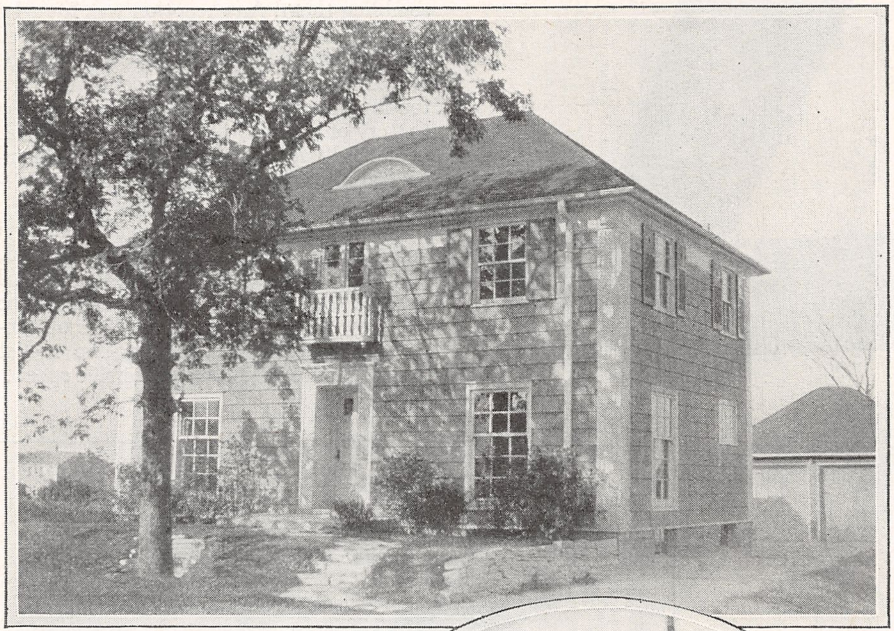
THE average high school boy might be content with building tables and chairs in his shop courses, but pupils of the Deerfield-Shields High School, at Highland Park, Ill., recently completed a whole two-story house. So well did they build it that it sold immediately upon completion for $13,500.

Fifty-five students, each outfitted with a pair of hickory striped overalls, a zigzag rule, and a pencil, reported for this unusual assignment in their vocational course in building trades. They were armed with plans of their own design. Their instructor, Walter E. Durbahn, organized them into squads according to their choice of work, each directed by a student "foreman."

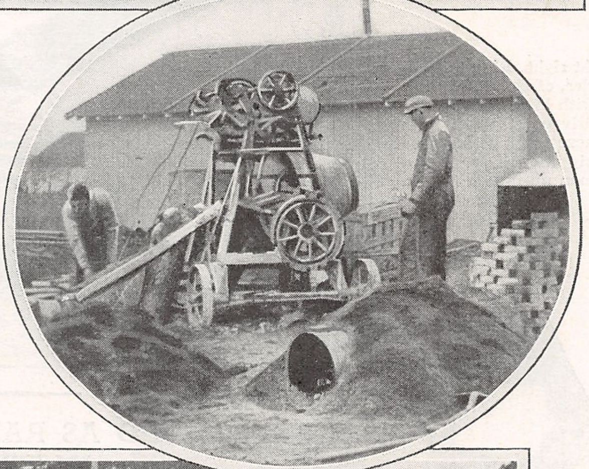
First, "masons" laid the foundation and then "carpenters" built the framework of the dwelling. "Bricklayers" installed the chimney and living room fireplace. "Plumbers," under tutoring of a journeyman, put in the necessary piping, and "electricians" placed conduits and outlets. Only the plastering was left to outside hands; the boys did all the rest themselves.

There were special individual jobs, too. The oldest and most skilled lad undertook to build the staircase, afterwards praised by skilled professionals. A young "furnace man" installed the heating plant and laid concealed air ducts along the ceiling of the recreation room in the basement, the "show" room of the house.

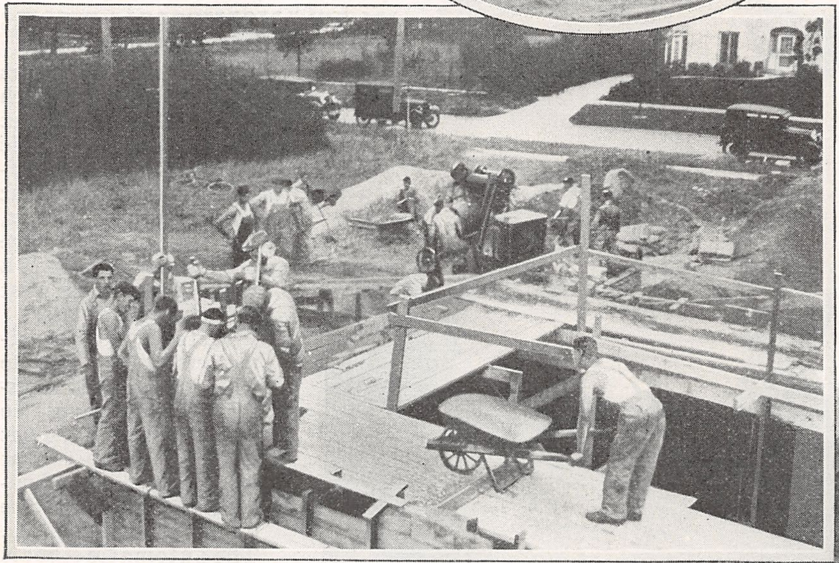
The new dwelling is not the first that Highland Park high school boys have built. They construct one each year, as a part of their vocational training. School heads consider this an eminently practical way to give the boys real trade experience of great practical value. The people who live in the houses have no especial sentiment about "helping the boys," but appreciate a good home when they see one that has been carefully and honestly built.



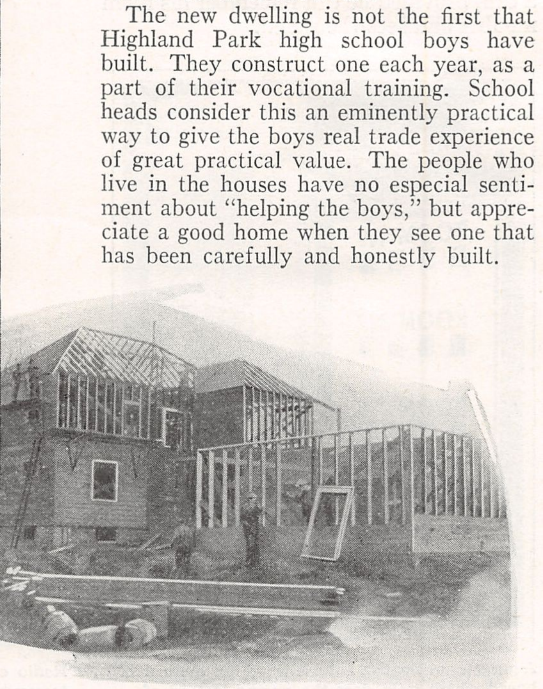
Here is the completed house that the Highland Park, Ill., students in the high school built as part of their vocational training course. Fifty-five boys worked at this building from plans that they drew themselves. When finished the dwelling was sold immediately for $13,500. One house like this is built each year.



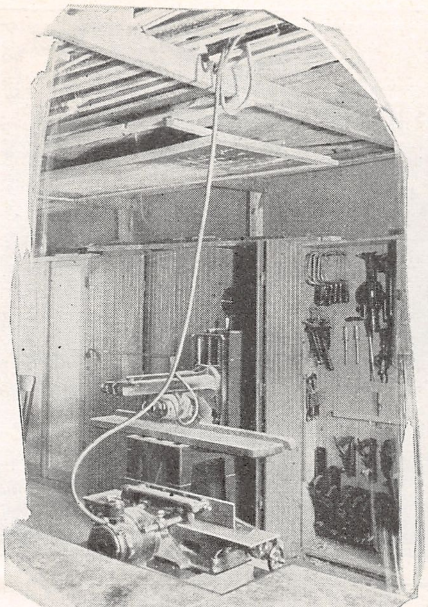
Cold weather could not stop these high school builders. At right is the concrete mixer which was kept in operation by heating the materials before they were poured into it. The boys were kept warm by the hard work.



Sinking the basement and pouring in the concrete for the foundation was a laborious operation, but the boys did it willingly to get experience.

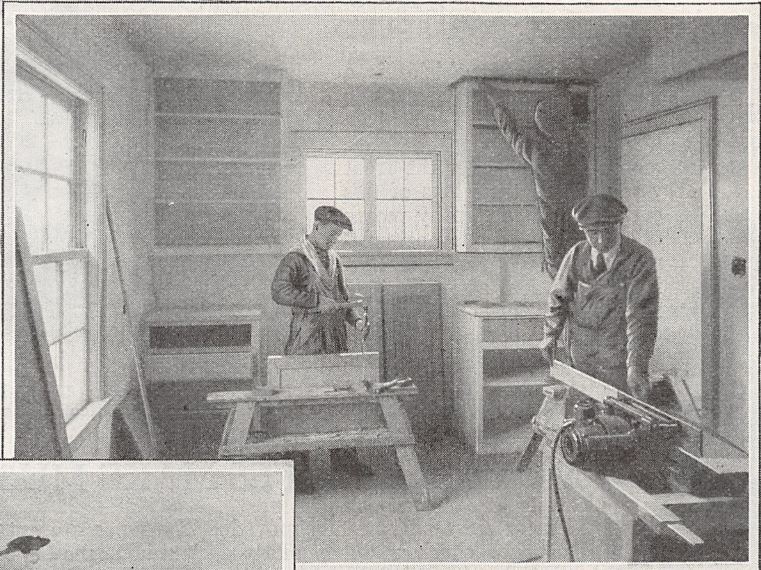


At right, the walls and the roof have been framed and considerable part of the sheething has been nailed on. This was hurried so work on the inside could be carried on after severe winter weather set in.



Above is the interior of the portable workshop which made it possible for the high school boys to do their building well and rapidly. In the picture can be seen circular saw, joiner, bandsaw, heater, and tool cabinets.

Almost completed. The finishing touches are being put on the exterior of the two-story house.. Young painters applied the protecting coats of paint while the landscape gardeners graded the yard and planned the gardens and flower beds.



Built-in cabinets are distinctive features of the boys' kitchen. Here are Edwin Schwalback, Herbert Bester, and Ray Smith, three of the high school students, busily engaged in cutting out, fitting together, and nailing the cabinets into place.

The youthful carpenters didn't even forget the ping pong table which is here seen set up and ready for action. This of course was placed in the recreation room, one room in the house which the boys took especial delight in planning and fitting.

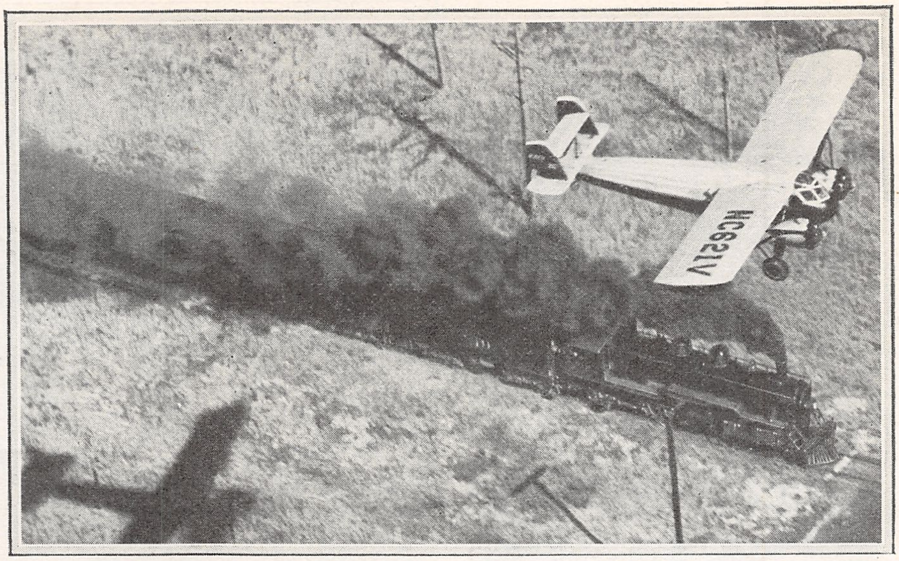
The most skillful and advanced of the high school boys were put to work on the staircase, as building stairs is a ticklish job for even an expert. Above, Irving Garling and Burton Berube are just completing the stairs in this high school home. Professionals examined their work and praised it.

At right, a cosy nook in the sun porch. This outside room is practically glass-inclosed with wide French windows and has been fitted up to give it an air of comfort. Notice ceiling light with closed globe and the transom effect in windows.

CAMERA CATCHES PLANE HOVERING OVER TRAIN

THE roar of its powerful motors blending with the muffled beat of the big express engine's exhaust, a giant transport plane drones along close above a speeding passenger train. Catching a moment when plane and train were close to each other, a photographer in another plane swooped down and made this striking picture of the plane speeding over the roaring express. The big transport plane is the first ship of the new Eastern Air Transport Line's fleet to go into service. This line now carries passengers between New York and Miami, Florida.

Opportunities for aerial travelers to look down on the older method of transportation at such close quarters are rare. Ordinarily they fly at such a height that it would be impossible to get a picture of a train and a plane at the same instant. In this case they were not together long for the train, the crack "Orange Blossom Special," could not keep up with its newest rival, and the plane soon outdistanced it and disappeared into the sky.



MIKE ON STAGE HELPS THE HARD OF HEARING

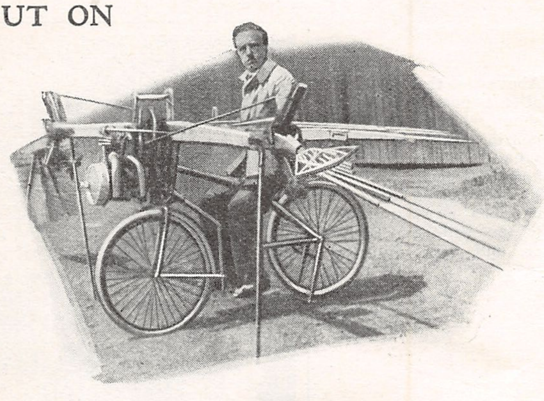
As OPERA glasses help those who have poor theater seats in seeing performances, so earphones help those who have difficulty in hearing words spoken from the stage. Engineers at Birmingham, England, following in the lead of several American theaters as described in this magazine, have installed headphones. Wiring permits a microphone on the stage to be connected with earphones anywhere in the audience.

TEST MIND AND BODY IN BREATH HOLDING STUNT

CANDIDATES for pilot's training with the British Royal Air Force are required to hold their breath for sixty-nine seconds as part of their physical fitness test. Then they have to tell the examiner why they could not hold it longer. This is supposed to be a good trial of their hearts, minds, and lungs. If a candidate holds his breath only a part of the required time, and then gives some silly reason for not holding it longer, it is assumed he will not make a good military airman. Holding it for the required length of time is taken to mean that he possesses the ability and the willingness to stick to a hard job and calmly face an emergency.

FEATHERED WINGS PUT ON BICYCLE FOR SPEED

STRANGEST of vehicles is a winged and feathered bicycle invented by an Austrian mechanic. A tiny gasoline motor mounted over the front wheel causes the wings of this odd machine to flap by means of a rope and pulley arrangement. The wings have a horizontal motion as well as a fore-and-aft one. They are covered by artificial feathers which are said to be weatherproof. Trials of the machine are expected to take place soon.

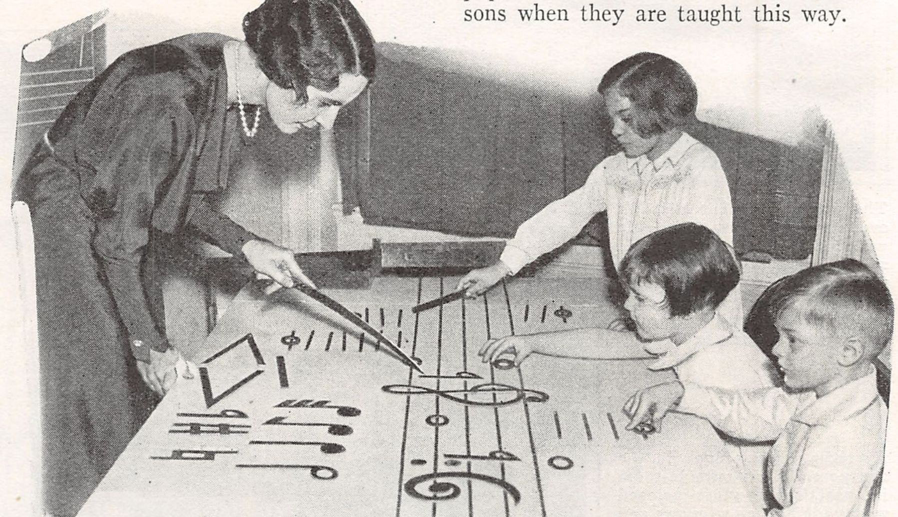


Flapping wings, covered with artificial feathers, were designed by an Austrian mechanic to speed up bicycle.

MOVABLE NOTES MAKE MUSIC A GAME

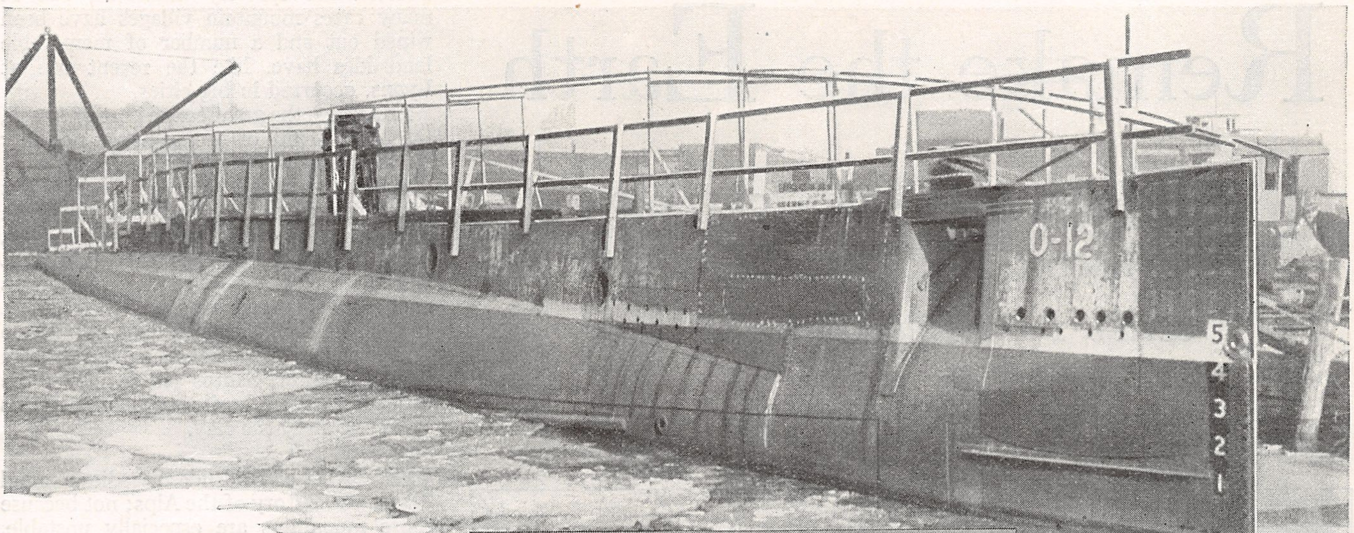
MUSICAL notes that can be moved about like checkers aid pupils to learn to read music. Miss Camille Allensworth, a Washington, D. C., music teacher devised this means for her pupils. A large table is ruled to represent the lines of a staff. The notes are cut out of cardboard and laid upon the table so they can be moved.

In order to make the game more interesting, the letters designating notes are incorporated into easily remembered nicknames. Some of these are "Tumble-down D," "Easy E," "Fatty F," "Alligator A," and "Grandmother G." It is said that pupils take more interest in music lessons when they are taught this way.



Miss Camille Allensworth, Washington, D. C., demonstrates movable notes to teach music.

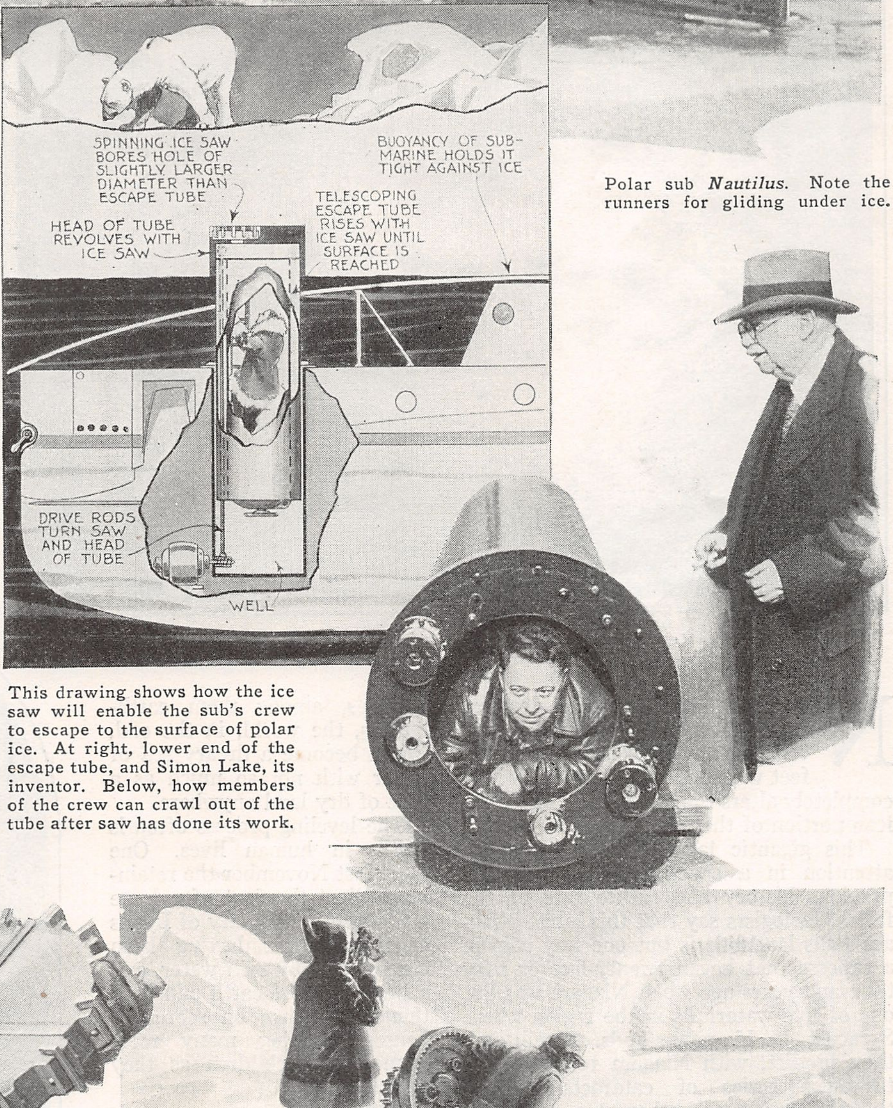
Polar Sub Can Drill Through Ice



Polar sub *Nautilus*. Note the runners for gliding under ice.

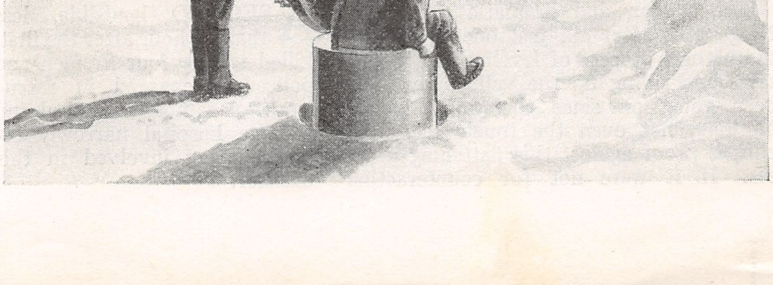
Sir Hubert Wilkins' submarine *Nautilus,* due to start this spring on an amazing under-ice journey to the North Pole, has just been fitted with a unique ice saw, or drill, at a Camden, N. J., shipyard. The device will bore a man-sized hole upward through thirteen feet of ice. It will enable the crew to leave the submarine for observations, or in emergency, through a telescoping "escape tube."

Wilkins expects to cruise from Spitzbergen to Alaska, on a voyage of undersea exploration. Simon Lake, pioneer submarine designer, invented the ice saw. If ice is too thick to use it, two smaller ice saws will bore eight-and-one-half-inch holes through 100 feet of ice.


SPINNING ICE SAW BORES HOLE OF SLIGHTLY LARGER DIAMETER THAN ESCAPE TUBE
BUOYANCY OF SUBMARINE HOLDS IT TIGHT AGAINST ICE
TELESCOPING ESCAPE TUBE RISES WITH ICE SAW UNTIL SURFACE IS REACHED
HEAD OF TUBE REVOLVES WITH ICE SAW
DRIVE RODS TURN SAW AND HEAD OF TUBE
WELL

This drawing shows how the ice saw will enable the sub's crew to escape to the surface of polar ice. At right, lower end of the escape tube, and Simon Lake, its inventor. Below, how members of the crew can crawl out of the tube after saw has done its work.

Sir Hubert Wilkins examining the ice saw with which his submarine for Arctic exploration, will be equipped.



Mighty Landslides Remake the Earth

Sun, Wind, and Water Join Forces in Constant Effort to Level Off World's Face Regardless of Man

By CALVIN FRAZER

Monte Arbino, the celebrated "moving mountain" of Switzerland. For a long time it advanced only about six inches a year. Then it quickened its pace and a great landslide occurred in 1928.

NIAGARA FALLS recently dropped 75,000 tons of rock from its crest, creating a V-shaped gap over 150 feet wide and 150 feet deep, which completely alters the contour of the American portion of the falls.

This gigantic landslide focuses public attention in a spectacular way on the previous history and future fate of the falls. Geologists say that this latest Niagara Falls landslide is but one tiny step in a process that began twenty-five or fifty thousand years ago when Niagara was but one of five waterfalls in the region where Syracuse, N. Y., now stands. It will end, they predict, with Niagara reduced to a turbulent series of cataracts dashing through masses of broken stone.

The sudden and dramatic change in Niagara is, after all, just one episode in the natural process of leveling the mountains and filling up the valleys that has been going on since the world began. Nothing, not even the toughest granite cliff, is proof against this flattening process. If it were not for counteracting agencies, among them earthquakes, the world, in the end, would become a dreary sea of water with not so much as a foot of dry land anywhere.

The leveling process often is costly in human lives. One night last November the retaining wall at the foot of a large hill in the French city of Lyons collapsed, after having been undermined by rain water, and a huge mass of earth and rock thundered down on scores of houses, burying many men, women, and children as they slept.

A SECOND landslide, less than an hour after the first, killed twenty-four firemen and policemen engaged in rescue work. A famous cathedral and a large hospital narrowly escaped being involved in this disaster.

Not a year passes without news of several more or less destructive landslides in various parts of the world. Usually the damage resulting from these events is relatively small because the regions affected are sparsely inhabited, but in many cases mountain villages have been wiped out and a number of memorable landslides have, like the recent one at Lyons, occurred in big cities.

At Santos, the great coffee port of Brazil, the adjacent hill of Monte Serrat not only sends down disastrous avalanches of mud which bury people in their homes, but every few days literally paints the town red. The hill consists mostly of red clay, which, when it rains, is carried over a large area of the city, coating the streets and sidewalks and clogging the sewers. Instead of sending out squads of men to shovel snow, as happens in our northern cities in winter, Santos sets a large force of laborers at work after heavy rainstorms shoveling away the clay.

RECORDS of landslide tragedies abound in the history of the Alps; not because those mountains are especially unstable, but because a large population has long occupied their flanks. In the night of September 4, 1618, the falling of the Monte Conto, in the Vale of Chiavenna, north of Lake Como, buried two small towns. Of their 2,430 inhabitants only three survived. Three villages with their entire population were overwhelmed by the fall of a mountain in the Treviso district in 1772.

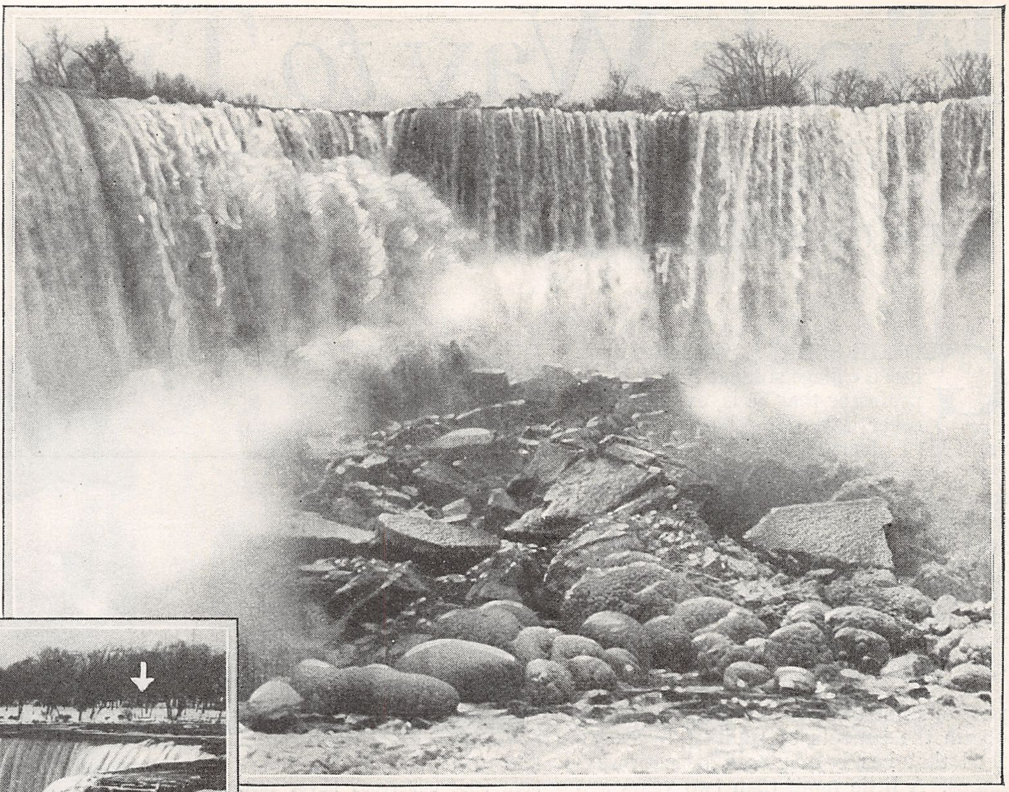
An outstanding disaster of the nineteenth century was the landslip of the Rossberg, which, on September 2, 1806, buried four villages in the valley of Goldau. After preliminary cracking of the mountain side and the rolling down of single stones, which lasted through the day, a huge chasm opened in the flank of the mountain about five in the afternoon. Then from the neighboring summit of the Rigi, the forest was seen to wave to and fro like a storm-tossed sea and the whole

Great masses of rock and earth thundered down upon a section of Lyons, France, last November, crushing homes and killing many persons. Here the rescue squad is at work. A second slide caught them and killed 24.

side of the mountain slid down with constantly increasing velocity, until finally hundreds of millions of cubic feet of rock swept down into the valley.

The friction of the rocks hurled together in their fall produced so intense a heat that flames were seen to flash forth from the avalanche, and the moisture with which they were saturated, being suddenly changed to steam, caused violent explosions. More than 450 lives were lost in this disaster.

Another historic Alpine landslide was the one that buried part of the village of Elm, in the canton of Glarus, on September 11, 1881. Above this village rose the precipitous peak of the Plattenbergkopf, at the foot of which there was a large slate quarry. The disaster was due to the quarrying operations, which gradually undermined the mountain mass above.



Above, the mass of rock in the foreground that recently fell from the American side of Niagara Falls. At left, contour view shows great indention made by the landslide. In time similar slips will level the Falls to a series of cataracts.

Above, a road in the Kansu Province, China, that was moved a mile by a big landslide of soft earth that claimed at least 100,000 victims.

A street in Bingham, Utah, through which flowed a great river of mud. Note the mud that struck the town last summer has nearly buried the houses.

Late in the afternoon great slides occurred on each side of the summit. The gashes left by them united below the peak and left its enormous mass without support. Four minutes later the whole 10,000,000 cubic yards of rock toppled over, crashed down upon a small valley above the village, dashed like a torrent of water up the opposite side of the valley, and then poured down the mountain side. About half the village was swept away.

MANY of the victims of this landslide were killed or mangled as the result of being hurled through the air by the terrific wind that rushed out in front of the descending mass of rock. The winds produced by great landslides and by avalanches of snow rival or surpass the worst blasts of the tornado. Eye-witnesses of the Elm disaster reported that trees were blown about like matches, that houses "bent, trembled, and then broke up like toys" before the landslide reached them.

On November 22, 1926, after heavy rains, a crevasse opened on the steep flank of the Maritime Alps above Roquebillière. During the night of November 23-24 a great mass of rock broke away and fell on the village, destroying a dozen houses and killing twenty-five people. The catastrophe was due to the saturation of the ground above a sloping bed of clay, down which the whole mass slipped.

On April 29, 1903, part of the town of Frank, Alberta, was buried by a landslide with a loss of seventy-five lives. The slip occurred on the side of Turtle Mountain, sending a mass of material nearly half a mile square and 400 to 500 feet deep into the valley below. The length of the slide was about two and a half miles, and the time it took was not more than 100 seconds. Heavy

(Continued on page 150)

Finds Way *to* Tune Rays *of* Ultra Violet

By

ALDEN P. ARMAGNAC

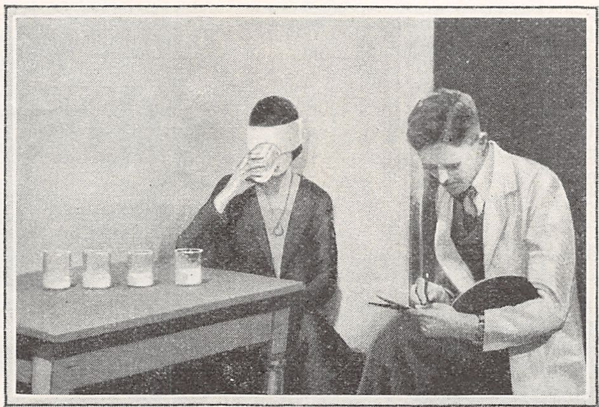
GEORGE SPERTI, who looks more like a college student than the full professor that he is, exhibited the other day a few bottles of milk from his University of Cincinnati laboratory. Experts tasted the milk, examined it, and were amazed. Not only was it perfect in flavor, but ultra-violet lamps had packed it full of Vitamin D, the healthful sunshine vitamin, without spoiling the taste, a difficulty that had balked all other experimenters who had attempted to treat milk with health rays. In other words, Sperti had done the "impossible."

For some time it has been known that people who cannot live outdoors may obtain the benefits of sunlight by eating food that has been placed beneath sunlamps. A little more than two years ago Professor Harry Steenboock, of the University of Wisconsin, discovered how to treat food in this way. But by his process only certain foods, notably cereals, could be health-ized. The process spoiled the taste of milk, which after "raying" tasted like burnt meat.

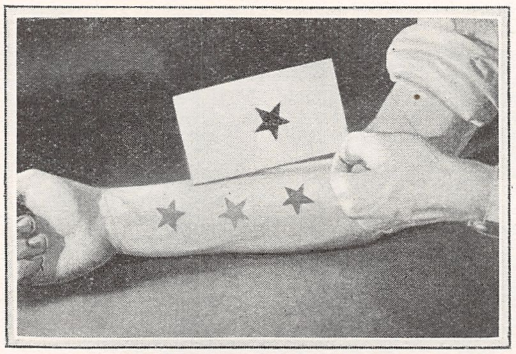
Now, by Sperti's new process, babies can have milk filled with the body-building vitamin and still fresh and sweet in flavor. His way of using "selected" or "tuned" ultra-violet rays successfully enriches other foods with vitamins. Bread, fruit, vegetables are some of the products through which you and I will benefit from Sperti's discovery.

THE University of Cincinnati has just arranged with a nationally known food concern to manufacture food impregnated with vitamins by Sperti's new process. To appreciate the significance of this, just recall that only twice before has a great university gone into the manufacturing business. Each time it was for a reason of commanding importance—first, to produce insulin, treatment for diabetes, and then to "ray" food by Steenbock's process.

Sperti, instead of keeping for himself patents that might make him a millionaire, has given them to the University of Cincinnati. Profits will be used to carry on further research in the same field.

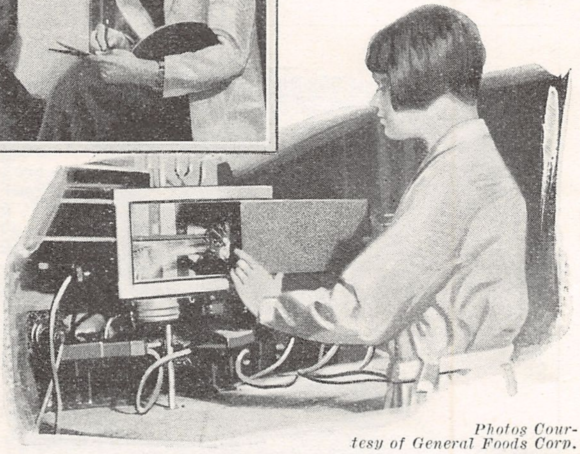


Milk into which vitamin D has been shot undergoes flavor test.



Sperti deliberately burned these stars on himself to prove all ultra-violet rays are not beneficial.

The new way to put sunshine in edibles is only one of the discoveries made by Sperti. Though he is only thirty-one, he probably has found out more about ultra-violet light than any other experimenter has in a lifetime. Among other things, he has produced a "death ray" that kills disease germs and makes possible the preparation of better vaccines for medical use.

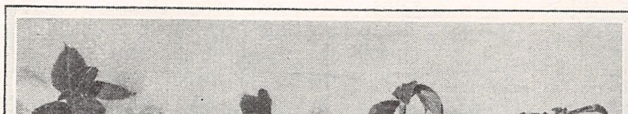


Photos Courtesy of General Foods Corp.

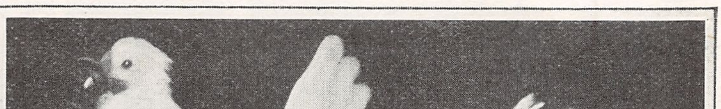
A sample for filter test is placed beneath one of Sperti's big lamps.

His work shows sunbathers what kind of a "tan" is healthy, and why. Florists may raise better flowers and poultry men better chickens, through the use of his "tuned" ultra-violet rays.

Almost ready to come out of his laboratory into commerce is a startling process that will preserve "perishable" foods for so many months that "out of season" may become an obsolete phrase.



Plant No. 1 received all of the ultra-violet rays while No. 2 received only selected rays. Note how No. 1 shriveled under treatment.



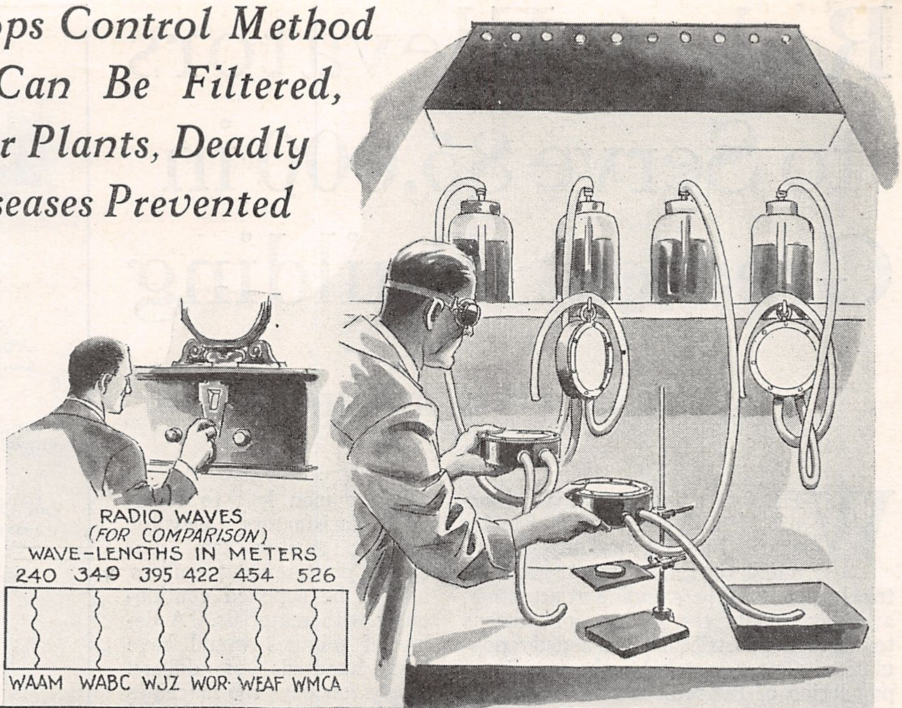
The chicken on the right has a bad case of rickets which the chicken on the left has escaped under proper treatment with selected rays.

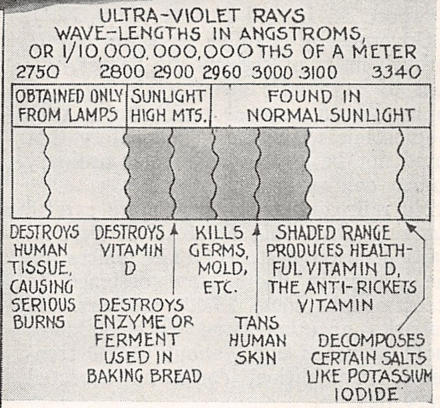
Young Scientist Develops Control Method So Harmful Waves Can Be Filtered, Vitamins Put in Food or Plants, Deadly Microbes Killed, and Diseases Prevented

What does Sperti mean by "tuning" ultra-violet rays? Much as they are talked about at present these invisible rays have not previously been fully understood.

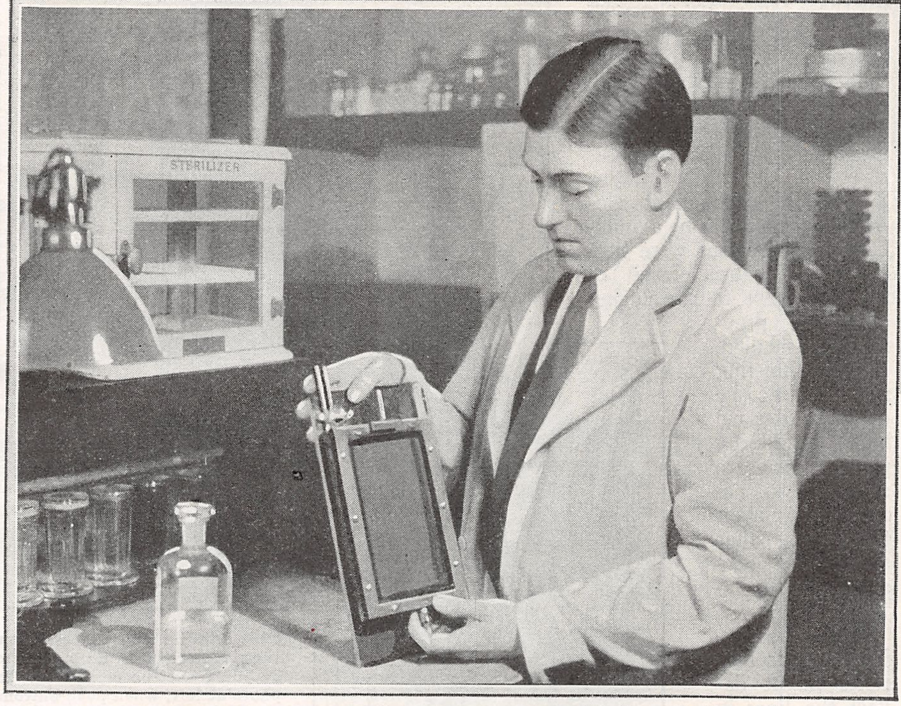
ULTRA-VIOLET rays, potent and varied in their effects, tan human skin, manufacture the health-giving substance called Vitamin D in the body, kill germs, and spoil the taste of certain foods.

Few before Sperti realized that *different kinds of ultra-violet light,* according to their wave length, might cause these varied effects, some good, some bad. Nor did a few random experiments with individual wave lengths of ultra-violet light settle it. Sperti proved there are different kinds and showed how to separate the good from the bad.


RADIO WAVES
(FOR COMPARISON)
WAVE-LENGTHS IN METERS
240 349 395 422 454 526
WAAM WABC WJZ WOR WEAF WMCA


ULTRA-VIOLET RAYS
WAVE-LENGTHS IN ANGSTROMS,
OR 1/10,000,000,000 THS OF A METER
2750 2800 2900 2960 3000 3100 3340
OBTAINED ONLY FROM LAMPS
SUNLIGHT HIGH MTS.
FOUND IN NORMAL SUNLIGHT
DESTROYS HUMAN TISSUE, CAUSING SERIOUS BURNS
DESTROYS VITAMIN D
KILLS GERMS, MOLD, ETC.
SHADED RANGE PRODUCES HEALTH-FUL VITAMIN D, THE ANTI-RICKETS VITAMIN
DESTROYS ENZYME OR FERMENT USED IN BAKING BREAD
TANS HUMAN SKIN
DECOMPOSES CERTAIN SALTS LIKE POTASSIUM IODIDE

This diagram gives a clear idea of how the rays are tuned out by filter very much as radio tunes out waves.


STERILIZER

Professor George Sperti, who has performed new wonders with "tuned" ultra-violet rays. Here he is seen holding one of the filters used to select the ray desired for experiment.

Much as a radio listener tunes his receiver to a particular wave length to hear his favorite broadcasting station, so Sperti now "tunes in" any wave length of ultra-violet light from the sun lamps in his laboratory.

If he desires, he can turn on a ray that tans human skin or switch to one that sears it. A slight adjustment, and he turns on the "death ray" that kills germs. When he wants to put Vitamin D in milk, he simply "tunes in" the ray that builds the vitamin and "tunes out" the ray that spoils the taste.

This is how he does it: Picture him placing a flat vessel of green or blue liquid beneath an artificial sunshine lamp. This liquid "filter" permits only the desired wave length of ultra-violet light to pass through. A row of round and oblong filters lines his shelf, each marked in pen-and-ink numbers with its wave length. The tinted liquids are chemical solutions that absorb all but certain rays of ultra-violet light, to which they are transparent. They flow into the filters through rubber tubes from large crocks, whose variety of color suggests the many-hued vessels that once were prominent in a druggist's window.

WHEN I went to see Professor Sperti to find out how he had made his discoveries, it was the man himself who interested me even more than what he had done. If I had expected to find a bearded savant, I should have been disappointed. Though he directs a research laboratory where thirty young men and women work, it was a slight figure animated with boyish enthusiasm who firmly grasped my hand.

When George Sperti was a twenty-two-year-old engineering student at the University of Cincinnati, he designed an electric meter of entirely new type to measure the amount of current consumed by factories. He submitted his plans to the Westinghouse Company. Officials of that concern urged him to leave the university and come with them to help manufacture the meter. Sperti declined. So they bought his invention anyway—for the second highest price, some say, that Westinghouse ever paid for a patent.

THE president of the university, hearing of Sperti's invention, called in the young student for a talk. He urged Sperti to remain and work there after graduation. That was why Sperti declined the electrical firm's tempting offer. The president had listened sympathetically to an ambitious plan of Sperti's—to set aside a laboratory where he could apply his mathematical and engineering talent to new researches into the mysteries of ultra-violet light and other rays. Sperti believed he could calculate, on paper, just what wave length of ray would be required to produce any given effect from tanning skin to killing

(Continued on page 132)

Robot Elevators to Serve 85,000 in Greatest Building

By KENNETH M. SWEZEY

WHEN in a few weeks the doors of New York City's Empire State Building are opened to admit the public, fifty-eight electrical robots will be standing at attention, awaiting merely the pushing of buttons to begin the distribution of a daily population almost equal to the combined population of the famous summer resorts Newport, R. I., and Atlantic City, N. J.

Governed by complex electrical brains, through miles of copper-wire nerves, this fleet of automatic elevators is expected to handle an unprecedented traffic with a smoothness, swiftness, and safety that could not be approached under ordinary human control.

No railroad has required more careful planning than this greatest of vertical transportation systems. The offices on the eighty-six floors were designed to accommodate some 25,000 workers. If statistics of other large office buildings could be relied upon, about 60,000 transients, in addition, could be expected every day.

Not only would it be necessary to transport this army of 85,000 persons to the desired parts of the building and down again, but all the floors would have to be served with nearly equal speed and comfort. If the value of office space is not to decrease with height, the eightieth floor will have to be as easily accessible as the tenth or the twentieth.

Besides, there loomed the highly concentrated traffic of rush hours. Figures gave evidence that in the minutes between 5 and 5:30 P.M., for instance, about 15,000 persons would have to be brought to the ground floor.

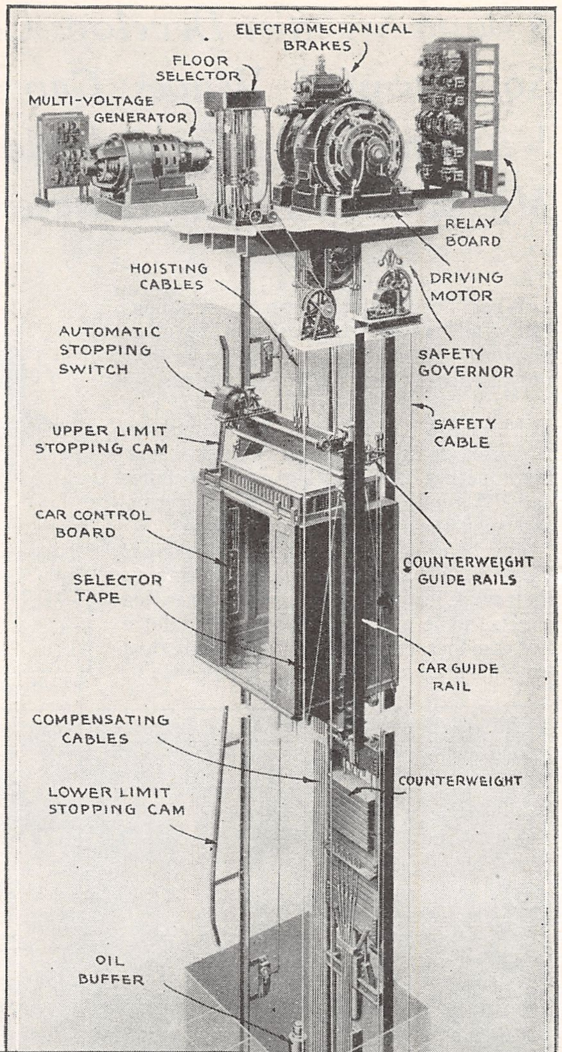
ENGINEERS and architects worked together over the problem, leaving no detail out of consideration. It was finally decided that fifty-eight elevators with automatic starting, stopping, leveling, and door opening and closing devices could most efficiently handle the bulk of the work. Nine additional elevators, with various degrees of self-operation, were decided upon for use in the top seven stories, the tower, and for freight service. The entire elevator installation, including such related work as the preparation of hatchways, cost about $4,000,000.

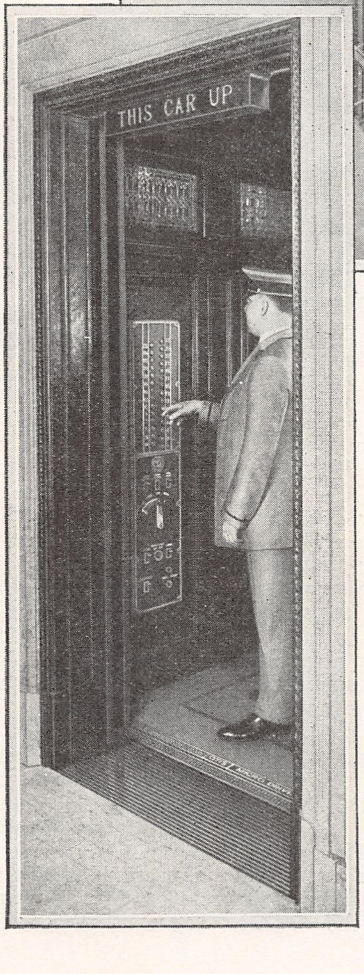
The job of the construction gangs, electricians, and engineers in their many months' work on this contract has not been simple. As the steelwork of the building rose higher and higher, the elevator men had to maintain satisfactory elevator service; steel-workers, masons, plasterers, plumbers had to be supplied continuously with materials. A delay of minutes would have cost hundreds of dollars. Every few days the machines for these temporary elevators had to be raised. To save expense, several elevators that had been salvaged from the old Waldorf-Astoria Hotel were drafted for temporary service.

FOR the permanent elevator installation, a number of innovations were necessary. Because eleven of the cars were to rise higher than any previously installed, larger hoisting motors had to be designed and built. Ordinarily plumb lines are sufficiently accurate to align the rails that guide the cars and counterweights.

However, fearing that air currents might deflect the lines in some of the tremendous shafts of the Empire State Building, the rails were aligned by sighting through mine transits—surveyors' instruments adapted by mining engineers for determining the straightness of mine shafts.

A larger construction crew was required than on probably any earlier installation. Through one period over 300 elevator men were working simultaneously.

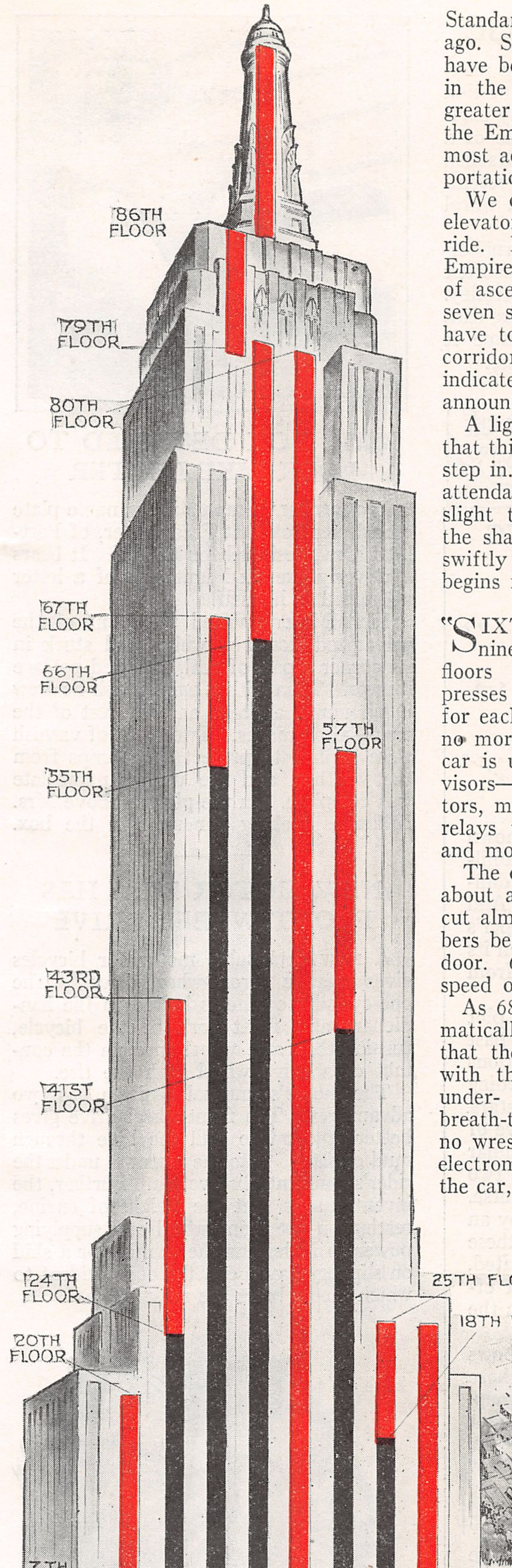




This drawing shows clearly how the elevators in the Empire State Building will be controlled. In photo at left, when push buttons are pressed car automatically stops at various floors designated.

For many years the Otis Elevator Company, which has the contract for the present installation, has been developing what it calls "signal-control" elevators. These machines were originally developed for slow-speed, operatorless, foolproof service in apartment houses. When tall buildings made high-speed elevator operation essential, the necessity for automatic control became clear at once and development took a new direction.

The first signal-control elevators in New York City were installed in the



Red lines in drawing at left indicate banks of local elevators and black are the express banks.

Standard Oil Building, about six years ago. Since that time many improvements have been made. The installation in use in the Chrysler Building, and the still greater one soon to be in operation in the Empire State Building, represent the most advanced systems of vertical transportation in the world.

We can best get an idea of automatic elevator magic by taking an imaginary ride. For an example let us enter the Empire State Building with the purpose of ascending to the seventy-ninth floor, seven stories below the top. We do not have to search long among the elevator corridors for the correct bank, which is indicated by an electric sign that announces: 66TH TO 80TH FLOORS.

A light above one of the cars indicates that this car is the next one to leave. We step in. In a jiffy a jewel flashes on the attendant's control panel. He gives a slight throw to a lever. The doors of the shaftway and of the car silently and swiftly close, and the car automatically begins its smooth and fast leap skyward.

"SIXTY-EIGHT," "seventy," "seventy-nine," the passengers announce their floors to the attendant, who merely presses a button on the control panel for each number called. He need worry no more. Once the doors are closed the car is under the care of invisible supervisors—cams, cables, governors, generators, motors, brakes, switches, rheostats, relays that are quicker, more sensitive, and more positive in action, than he.

The car continues to speed upward for about a minute (this time will later be cut almost in half), then suddenly numbers begin to flash on a panel above the door. 66, 67. Almost imperceptibly, the speed of the car is retarded.

As 68 flashes, it stops, the doors automatically glide open, and we discover that the car has leveled itself perfectly with the landing. There has been no under- or overshooting of the mark, no breath-taking acceleration or retardation, no wrestling with the doors. A gang of electromechanical geniuses, hidden about the car, in the shaftway, and in the motor room, have done away with all that.

After two of the passengers have stepped out, the attendant again gives a slight throw to the lever, which initiates the closing of the doors, and the car proceeds. For every button that has been pressed, the elevator automatically makes the same sort of gentle, swift, and accurate stop. Not only does it stop in response to buttons on the operator's panel, but to buttons pressed by passengers waiting at hall landings. In which case the stop is made entirely without the attendant's knowledge.

TO economize to the utmost in waiting time, only the car that will actually stop to take on a passenger will flash a light in the hall. Ordinarily, the first car traveling past the landing in the direction desired must automatically stop; but when a car is full, the attendant, by throwing a switch on his control board, may relay all calls to the next available car.

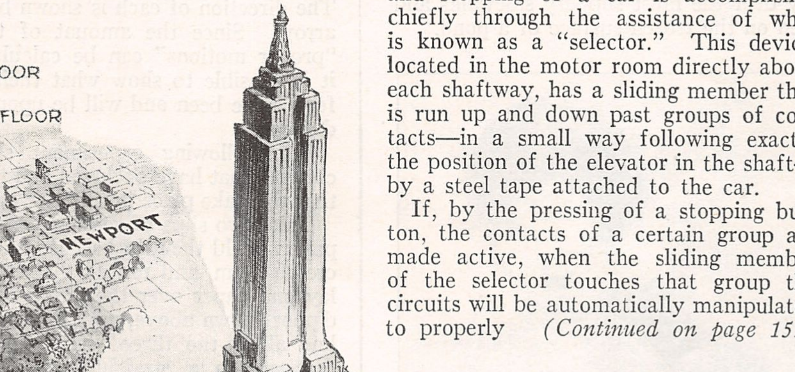
When we have finally been let out at the seventy-ninth floor, we find ourselves turning over in our minds some possible explanations for what we have experienced. Without human intervention we have been whisked some 940 feet from the ground—about seven stories higher than the McAlpin, Biltmore, and Pennsylvania Hotels piled on top of each other—lights have flashed, the car has stopped at desired floors, and doors have opened. How silly seem the tin-clad dummies of the scientific lecture, that wink their eyes, salute, and say "hello," compared to the practical everyday elevator Robot.

THE controlling and operating equipment is by no means simple. To interconnect all the electrical circuits required by the elevators in this one building, nearly 8,000,000 feet of rubber-covered wire were necessary—more than enough to reach from Boston to Kansas City. In addition there are thirty-six miles of conduit. The length of the hoisting ropes, compensating ropes, and governor ropes exceeds 120 miles.

Accelerating, slowing down, leveling, and stopping of a car is accomplished chiefly through the assistance of what is known as a "selector." This device, located in the motor room directly above each shaftway, has a sliding member that is run up and down past groups of contacts—in a small way following exactly the position of the elevator in the shaft—by a steel tape attached to the car.

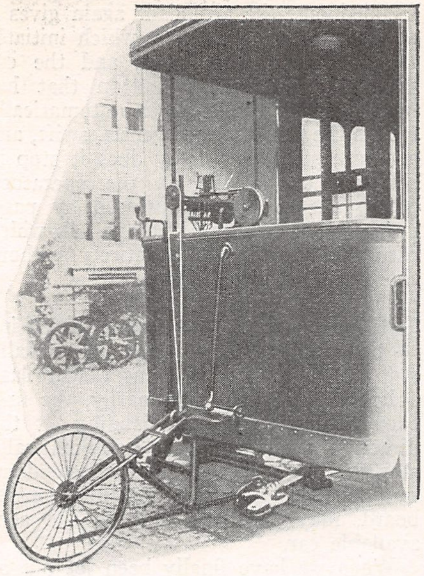
If, by the pressing of a stopping button, the contacts of a certain group are made active, when the sliding member of the selector touches that group the circuits will be automatically manipulated to properly

(Continued on page 151)



Each day elevators in this great building will carry more people than live in these cities.

WHEEL RECORDS STREET CAR MILEAGE



Attaching a trailing-wheel to the rear of street car, Berlin engineers learn how far it travels.

How far do trolley cars travel in making a day's run? This is one question that Berlin, Germany, street railway engineers are seeking to answer by use of a trailing-wheel measuring device attached to their cars. The trailing wheel resembles part of a bicycle frame, with wheel attached.

A driving gear working from a rubber-tired wheel operates a distance-recorder mounted on the rear platform of a trolley. A clockwork attachment also gives data on the trolley's speed and the time it requires to cover a designated route.

NONSKID OVERSHOES LIKE AUTO CHAINS

A YOUNG woman of Birmingham, England, borrowed an idea from motor cars to make walking safe on icy pavements. She has made herself a set of overshoes from wire netting. They work on the same principle as skid chains which motorists fit over their tires when the going is slippery.

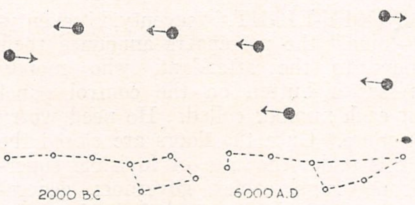
The wire which is used resembles chicken fence wire, but it has a smaller mesh. Overshoes made from this material are pliable and may easily be carried in a traveling bag or a pocket when they are not in use.

The new "foot chains" can be worn either over rubbers or ordinary walking shoes. They are light in weight and cause no discomfort to the wearer. Their young inventor says that when wearing them she can walk with perfect ease and security over the most slippery sidewalks and even on the frozen surface of a pond.

Overshoes covered with this wire netting can be worn on slippery streets without a fall.

Five Minutes of
ASTRONOMY

BIG DIPPER TURNING INTO FRYING PAN



THE constellation of stars known as the "Big Dipper" is such a familiar feature of the sky that it is difficult to imagine any change in it. And yet the arrangement of the dipper's seven stars is different today from its pattern of 4,000 years ago and from its shape 4,000 years from now.

Astronomers are enabled to plot the pattern of the dipper, both past and future, because of the revelations the spectroscope has made regarding the "proper motions" of these stars.

It has been discovered that five of the seven are traveling at similar speeds in one direction, and the two others are on an opposite course. The direction of each is shown by an arrow. Since the amount of these "proper motions" can be calculated, it is possible to show what their effects have been and will be upon the dipper.

The following experiment shows changes that have occurred and those that will take place in this star group.

Take two slips of semi-transparent paper. Fold them in half lengthwise, crease them, and unfold them. Now lay one paper over the figure of the dipper shown above, with the creased line along the three "handle stars" that are in a straight row. Trace through with a pen the five dots representing the stars whose arrows point left. Repeat the process with the other slip of paper, but trace through the stars whose arrows point right.

If the two slips are now held in contact toward a lamp, with their creases coinciding, and moved slowly upon each other, all the varying appearances of the big dipper, past and future, can be illustrated, as indicated in the small diagrams.

MAIL BOX DESIGNED TO LOOK LIKE LETTER

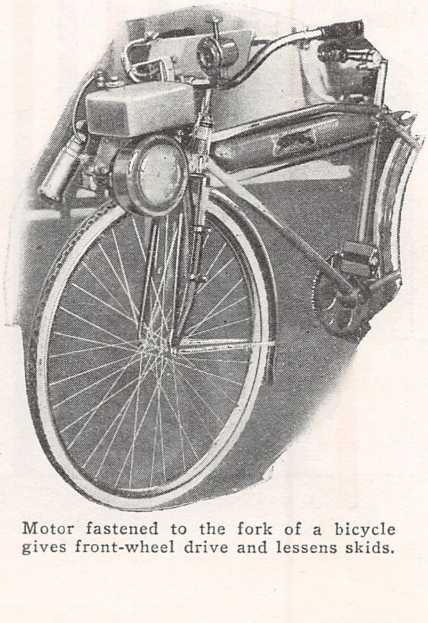
INGENIOUSLY graphic is the name plate on a letter box that Fred Miller, of Portland, Ore., designed for himself. It bears a cleverly executed imitation of a letter addressed to himself.

First Miller painted the front of the galvanized iron box white, and stuck in its corner a pair of real, canceled postage stamps. Then with a paint brush he drew in his name, address, and the rest of the cancellation marks. Two coats of varnish were applied to protect the stamps from the weather, and the unique nameplate was complete. In the picture above Mrs. Miller is looking for mail in the box.

NEW MOTOR BIKE HAS FRONT-WHEEL DRIVE

A NEW detachable motor for bicycles gives them a "front-wheel drive." The one-cylinder engine is bolted to the handlebars and front fork of the bicycle, turning the front wheel through the contact of a drive wheel with the tire.

The motor's unusual position has two advantages. The front-wheel drive gives better traction to pull the bike through mud or sand. Also the motor is under the rider's constant observation. Further, the inventor says that the weight of engine, resting on the front wheel and supplying power to it, lessens the chance for a skid on slippery pavement, the one accident to which motor bikes are most liable.



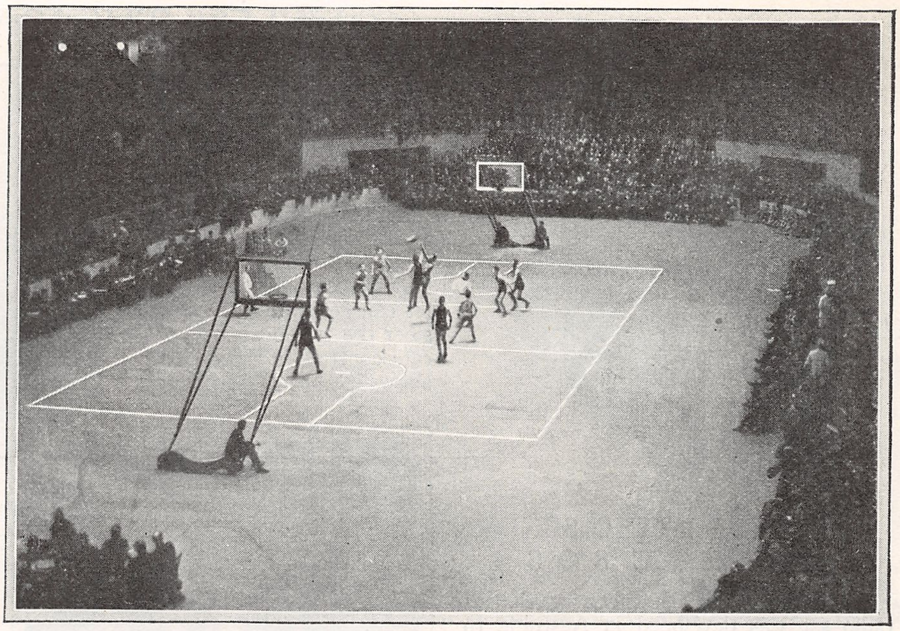
Motor fastened to the fork of a bicycle gives front-wheel drive and lessens skids.

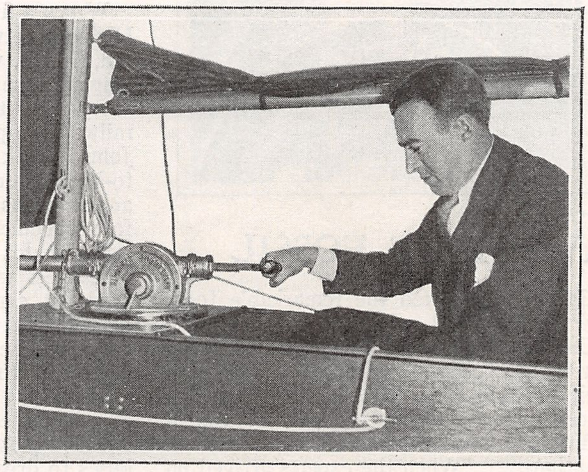
HONDURAS MOTH NINE INCHES ACROSS WINGS

A rare moth of great size, captured by a scientific expedition in Honduras, Central America, was presented to the Philadelphia Academy of Science not long ago. It measures nine inches between the tips of its wings.

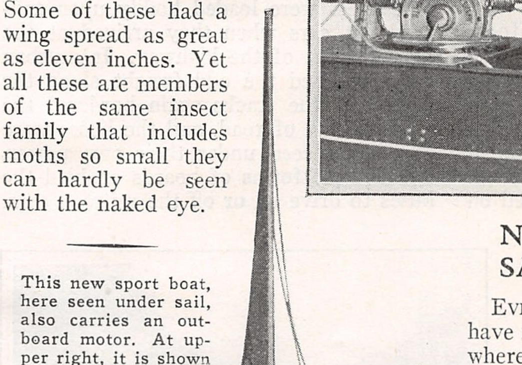
Even without its wings, the bulky body of this moth would entitle it to a place among the largest of insects. The expedition spent six weeks in the jungles of Honduras to bring back this and other specimens.

Moths of even greater size have been captured before, records show. Some of these had a wing spread as great as eleven inches. Yet all these are members of the same insect family that includes moths so small they can hardly be seen with the naked eye.





This new sport boat, here seen under sail, also carries an outboard motor. At upper right, it is shown propelled by hand.



NEW BOAT DRIVEN BY SAIL, MOTOR, OR HAND

Even the most inexperienced person can have no difficulty in making a new boat go where he wants—for it runs either by sails, motor, or hand power. Vagaries of breezes or motors need have no terrors for the user of this strangest of water craft, which recently made its debut in New York City.

A twenty-foot removable mast carries enough sail to give the boat good speed with a favoring wind. Should the breeze fail, an outboard motor, mounted at the stern, is ready for use. For exercise or in emergency, the boat may be propelled by an ingenious hand lever resembling that of a railroad hand car, shown in the photograph above. It spins a second propeller located amidships, which is directed by foot pedals to steer or reverse the boat.

As novel as its propelling mechanism is the boat's design. Its hull is supported by two long pontoons, giving great stability and making a centerboard unnecessary for sailing. A bumper like that of an automobile, at the front, makes the boat more "foolproof" by preventing damage from collisions. The cockpit's furniture includes a sliding seat like an oarsman's in a racing shell for the operator of the hand lever.

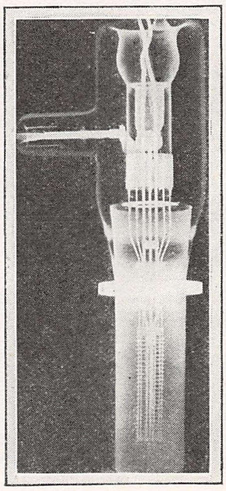
GLASS BACKSTOPS AID VIEW OF BASKETBALL

So that spectators behind the goals can see the most exciting moments of basketball games, backboards of glass instead of wood were installed recently at the Madison Square Garden, New York City sporting arena. Transparent panes made it possible to watch the movements of players and the ball right up to the moment when the sphere dropped through the basket. After the trial at an intercollegiate game, arena officials reported it a huge success. Hitherto unwanted seats were now in demand, since they were nearest to the goals.

The backstop supports slightly obscure the view, but with the board transparent, this difficulty was not found serious by recent record-breaking crowds.

X-RAY USED TO FIND RADIO TUBE DEFECTS

The X-ray has been put to work by the General Electric Company as an inspector of radio tubes. The illustration below shows an X-ray photo of the internal organism of a high-power short-wave industrial radio tube, made at its research laboratory. If any defects occur during the manufacture of these tubes, they are at once apparent to an examiner from a study of the X-ray pictures.

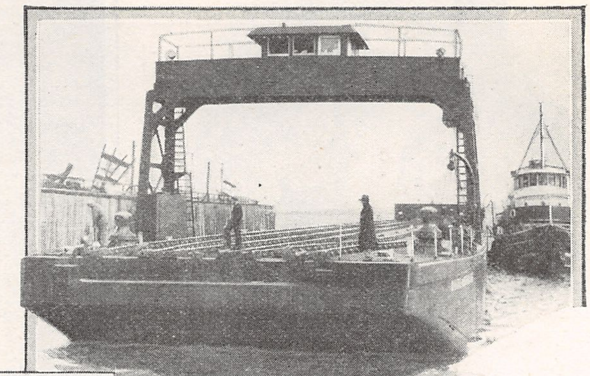


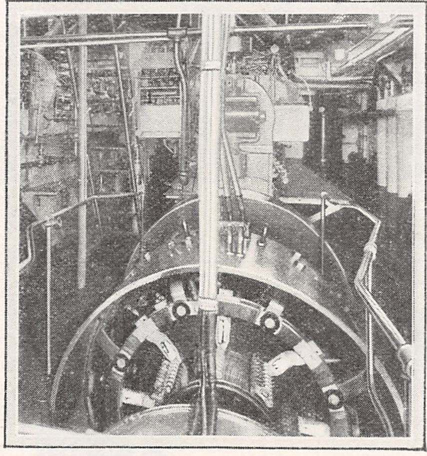
X-ray taken of radio tube to find any defect.

After the tubes are assembled, and before the air is exhausted from them, a photograph is made in order to see that all the delicate structure within is right. Just before the tube is shipped from the plant, a further picture is made as a check.

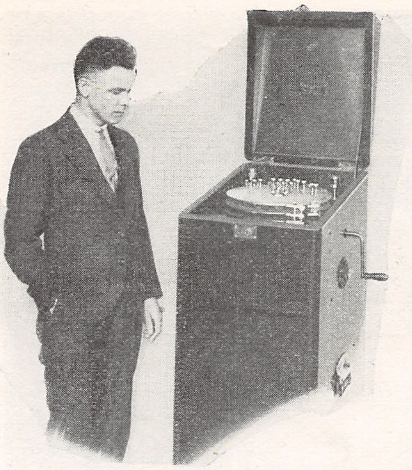
CREWLESS TUGBOAT TOWS BIG BARGE

WITHOUT a man for crew, the world's strangest tugboat was recently placed in service on the St. Lawrence River. Its Diesel-electric machinery is controlled through electric cables from a pilot house aboard the railroad barge that it tows. In his unusual position, the pilot can get a better view to steer the two boats. Duplicate controls in the tugboat allow it to be run alone.





Electric cables from the barge above run the tugboat that tows it. At left, motor room of the unusual tugboat that can be operated from the barge or by crew in charge of its own controls.



NEW TYPE RADIO SENDS AUTOMATIC S O S

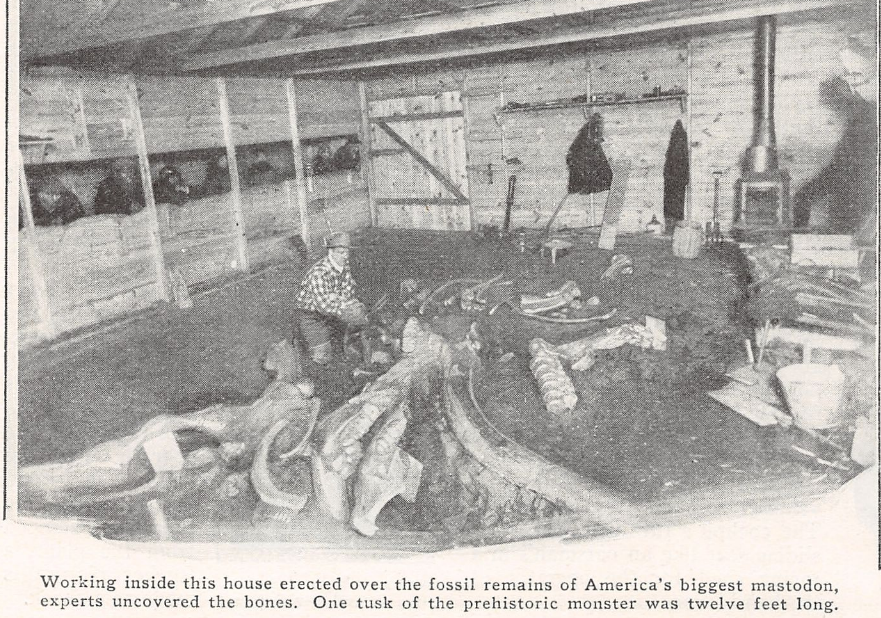
RESEMBLING a cabinet phonograph, this radio set was developed in Australia to send out automatic distress signals from sinking ships. A record takes the place of human fingers at its key, sending out code signals that have been heard 1,000 miles.

Records, furnished with each instrument, bear an S O S message signed with the ship's name and call letters. The records are so simple that extra ones giving the ship's position can be made on board ship in a few seconds.

BUILD SHED TO SAVE HUGE FOSSIL

BUILDING a house over a fossil skeleton in Indiana was the expedient resorted to by members of a Buffalo Museum of Science expedition when souvenir hunters and curiosity seekers endangered their work. Now they go peacefully on with their work of bringing to light one of the largest mastodons ever discovered in America, while visitors are allowed to peek from behind a stout wooden barrier, where they can do no damage. The scientists' "audience" can be seen at the left of the photograph below.

A ten-year-old farm boy, Donovan Harper, discovered the remarkable fossil near Cromwell, Ind. While crossing Charles Feldheiser's farm, on a skunk-hunting expedition, he stumbled over an eight-pound tooth unlike any he had ever seen. He took it to the farmer, who in turn communicated with the museum authorities. When the experts arrived on the scene they erected a frame structure over the skeleton and set to work patiently with hand trowels to excavate the precious bones. One tusk of this prehistoric monster was more than twelve feet long.

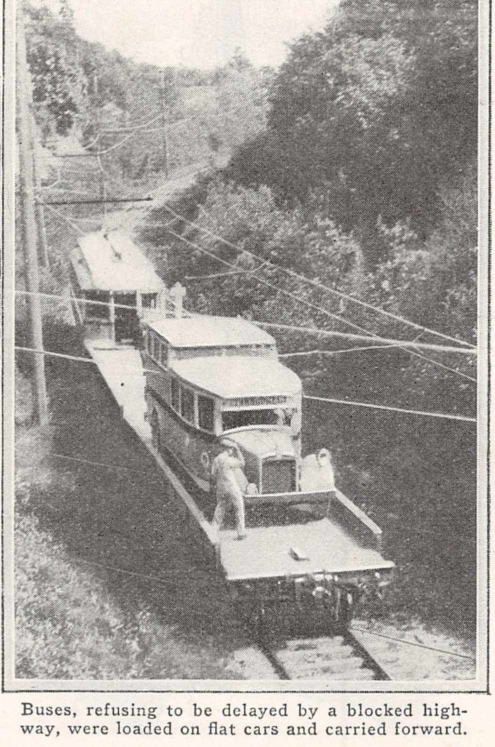


Working inside this house erected over the fossil remains of America's biggest mastodon, experts uncovered the bones. One tusk of the prehistoric monster was twelve feet long.

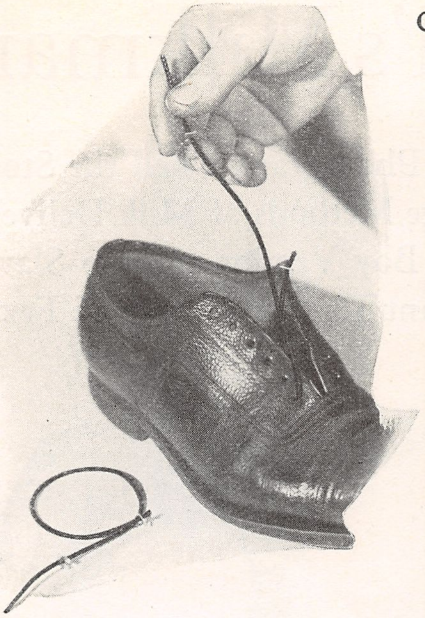
BUSES RIDE ON A TRAIN WHEN ROAD IS CLOSED

WHEN a five-mile portion of the Pacific Highway between Bellingham and Blanchard, Wash., was blocked for repairs, not long ago, the only detours available added many miles to the route. But an electric railway ran parallel to the auto route. So John Hickok, superintendent of a Seattle-to-Vancouver passenger bus line, devised an ingenious way to maintain the line's fast schedule.

Under his direction, buses filled with passengers were loaded bodily upon railroad flat cars when they arrived at the blocked part of the highway. Interurban cars propelled the odd freight along the rails until the tracks again bordered the clear section of road, and the buses were able to proceed under their own power. Inclined platforms of boards enabled the buses to drive on or off the railroad cars.



Buses, refusing to be delayed by a blocked highway, were loaded on flat cars and carried forward.



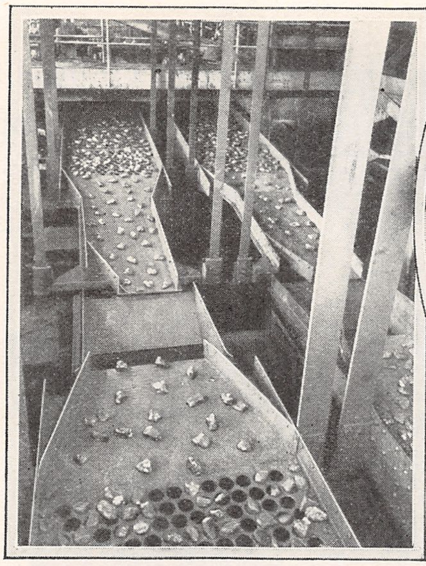
ELASTIC SHOE LACES WILL FASTEN WITHOUT KNOT

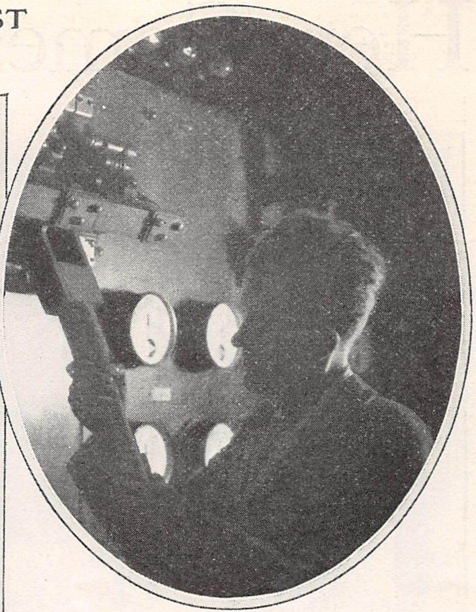
Elastic shoe laces, with a springy "give" designed to increase foot comfort, are a recent innovation. A single lace is used for each shoe. The black elastic cord is equipped with two slotted metal tabs, or anchors, of which one is attached before lacing the shoe.

Starting from the inside of the shoe, the wearer draws the lace through the bottom eyelet, as shown in the photograph above, up to the anchor. Then he criss-crosses it between eyelets until the top is reached. Here he draws the lace taut and attaches the second anchor.

With this novel device no knots are needed, and the new laces have sufficient elasticity to permit the shoes to be slipped on or off without unlacing them.

ONE MAN CONTROLS BIGGEST HARD COAL BREAKER



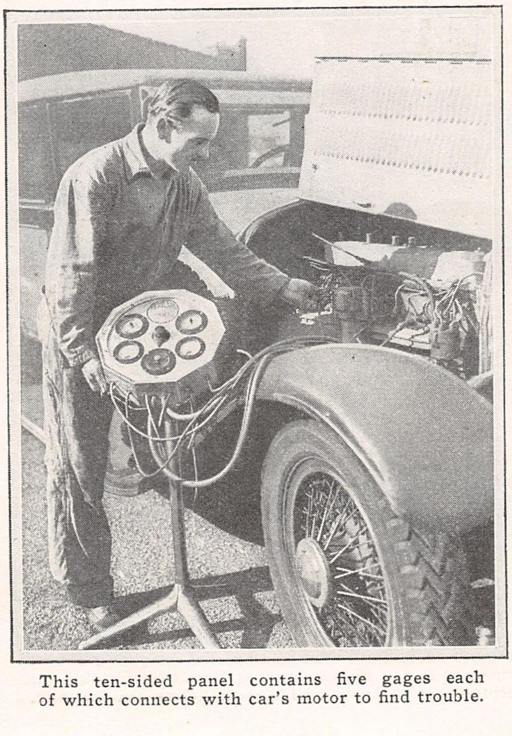


Above is the central switchboard that controls the world's biggest hard coal breaker. Lighted dials show at all times what is happening in every part of the plant. At left, the breaker seen at work crushing and sorting the coal into various sizes.

Although an ultra-modern anthracite coal "breaker" at Locust Summit, Pa., is the largest in the world, one man can set its massive machinery in motion. Its arteries of electric wires, carrying current to the powerful motors, are controlled from a single central switchboard. Hundreds of lighted dials give exact information as to what is happening in every corner of the plant from moment to moment.

The duty of the coal breaker is to crush the large irregular lumps of coal that come from the mine, and sort the fragments into convenient sizes for household and industrial use. This is happening in the illustration above, which shows vibrating screens giving the last sorting to egg coal. The electric master switch that starts the giant mechanism is seen being manipulated in the photograph at the upper right.

MACHINE FINDS ANY ENGINE TROUBLE



This ten-sided panel contains five gages each of which connects with car's motor to find trouble.

An instrument that diagnoses an auto motor's ills is the product of a California manufacturing concern. A ten-sided panel containing five gages and a rotating pointer is mounted on a portable stand. Wheeling it up to the car, a garage mechanic connects it to the car's engine by wires and tubes. Starting the motor, he notes the condition of its valves, valve timing, carburetor, and electrical system by readings taken from the dials. The rotating pointer indicates revolutions per minute made by the engine under observation.

This device is said to eliminate guesswork from the diagnosis of engine troubles. It also saves time for the customer, for his machine does not have to be kept under lengthy observation before the garage man can tell him what is wrong with its engine. This quick diagnosis is possible since each gage registers the condition of the particular part with which it is connected and also suggests the seriousness of the indicated trouble.

PORTABLE CAR POLISHER SPEEDS GARAGE WORK

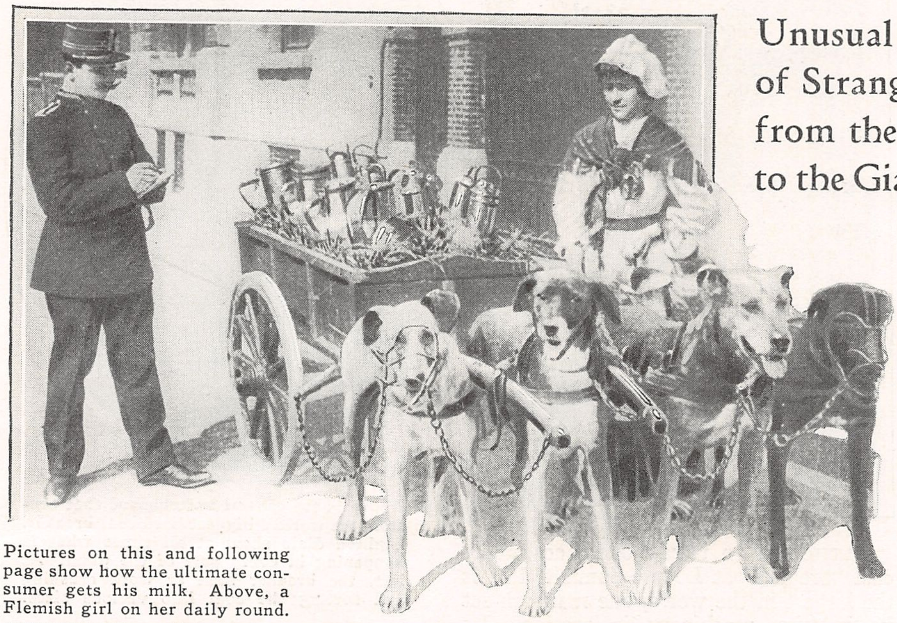
Electric power instead of "elbow grease" works a new car polisher made in Cincinnati, Ohio. A motor at its working end drives the buffer or polisher through angle gears. An electric cord, one end of which is plugged into a light socket, furnishes current to run this new tool, which is controlled easily by means of a switch conveniently located in the handle.

Aluminum is used for the motor casing and gear cover at the end, making it light and handy. It is said to have proved a convenience around garages or wherever there is much polishing done, saving a great deal of time and labor in putting a shine on motor cars or bright metal fittings. Its particular virtue is said to lie in the fact that it is so light it can be carried easily from place to place and operated from any electric current socket. The motor of the polisher will operate on either alternating or direct current.

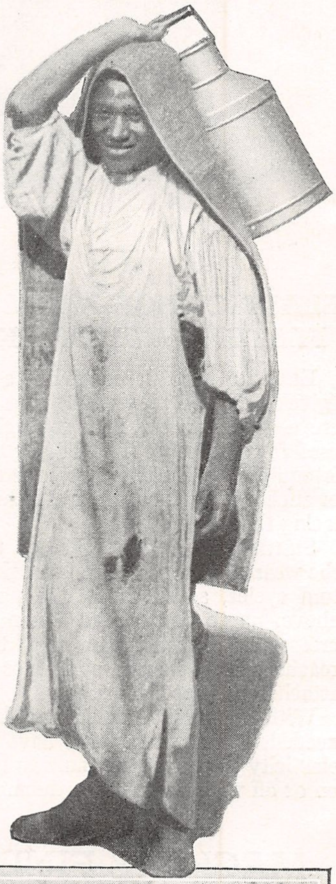
This electrical auto polisher saves time and labor in shining the body and metal fittings.

Here Comes the World's Milkman

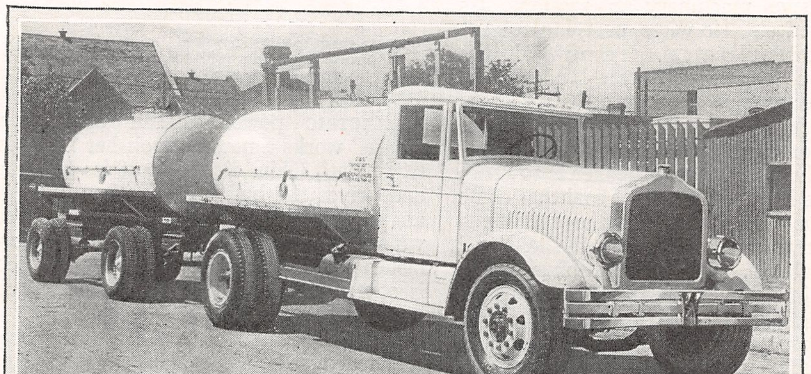
Unusual Photographs Tell the Story of Strange Methods of Milk Delivery from the Boy Vendor of Jugo-Slavia to the Giant Thermos Truck of Texas



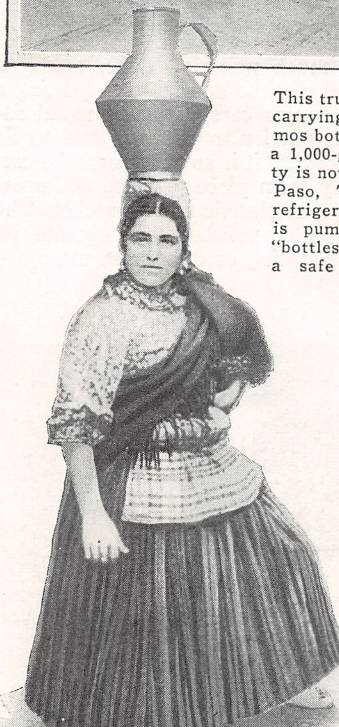
Pictures on this and following page show how the ultimate consumer gets his milk. Above, a Flemish girl on her daily round.



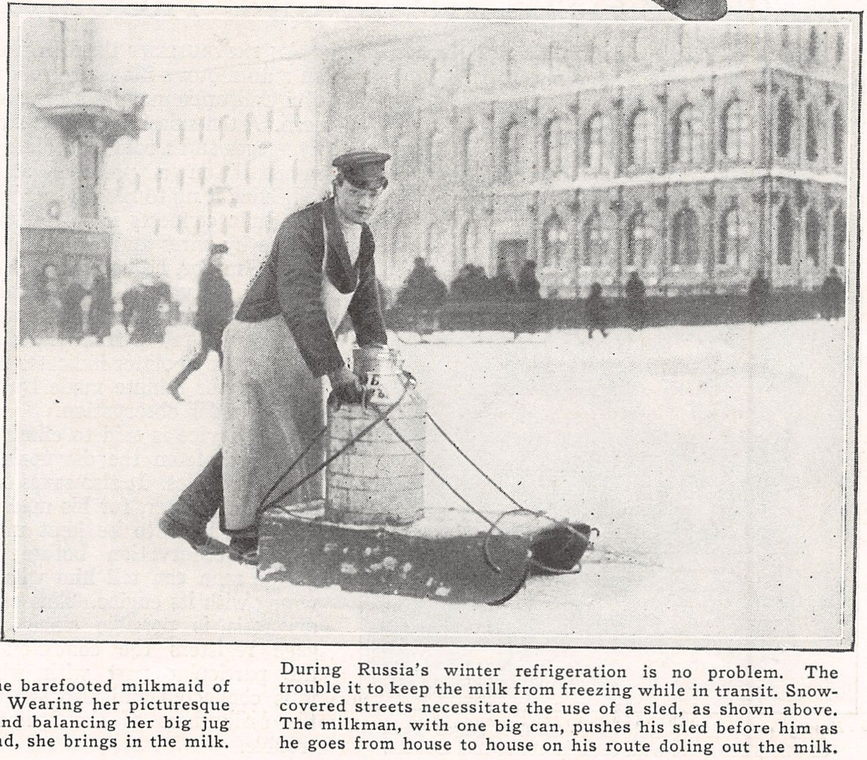
At right is a typical milk carrier of Tunis, northern Africa. There, where the tropic sun beats down fiercely, the milk can, carried on vendor's back has no chance to be cooled.



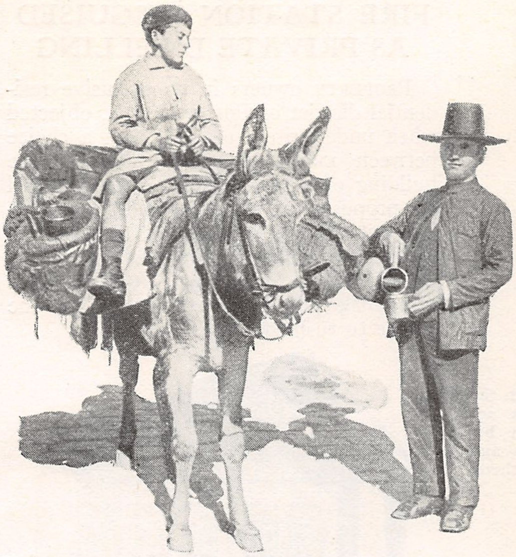
This truck and trailer carrying two big thermos bottles each with a 1,000-gallon capacity is now in use at El Paso, Texas. Milk, refrigerated before it is pumped into the "bottles," is held at a safe temperature.



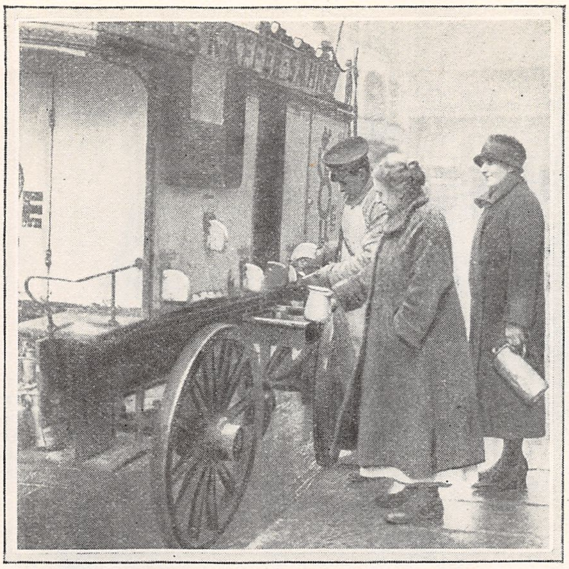
At left, the barefooted milkmaid of Portugal. Wearing her picturesque costume and balancing her big jug on her head, she brings in the milk.



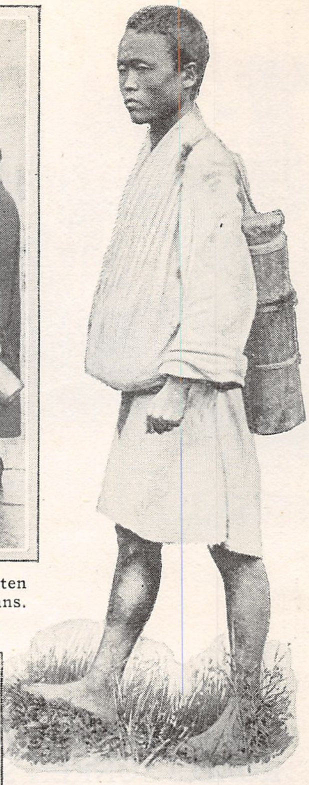
During Russia's winter refrigeration is no problem. The trouble it to keep the milk from freezing while in transit. Snow-covered streets necessitate the use of a sled, as shown above. The milkman, with one big can, pushes his sled before him as he goes from house to house on his route doling out the milk.



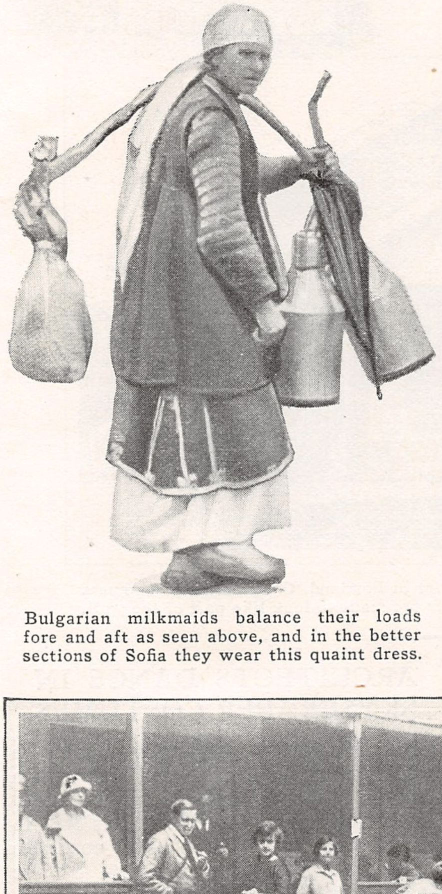
The bray of the donkey is heard in Seville, Spain, as the boy with his cargo of milk comes down the street. The sturdy little beast can carry a big load and the patron with his own mug helps himself.



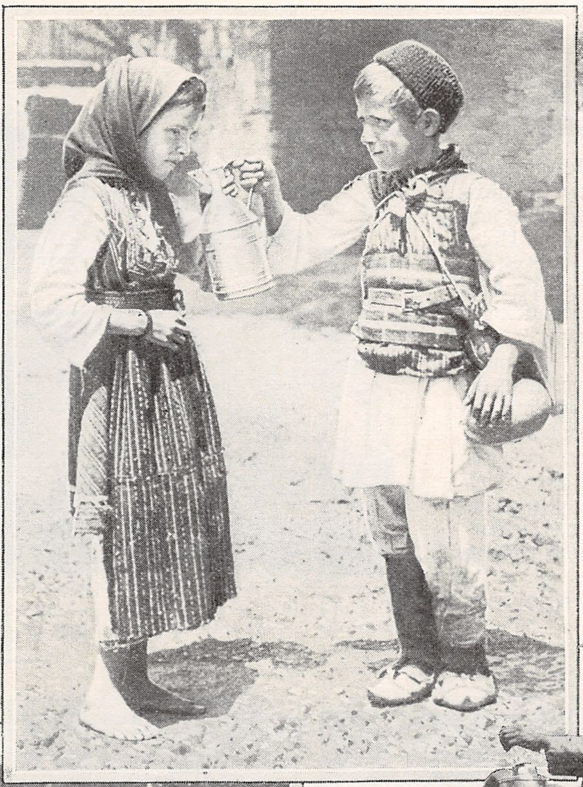
Berlin, Germany, does it like this. The milk wagon has ten taps from which the customers draw milk into their cans.



In India the milkman goes on foot, a small bag of milk slung to his back. No effort is made to keep the milk cool and in hot mornings of that southern land, it probably often sours.

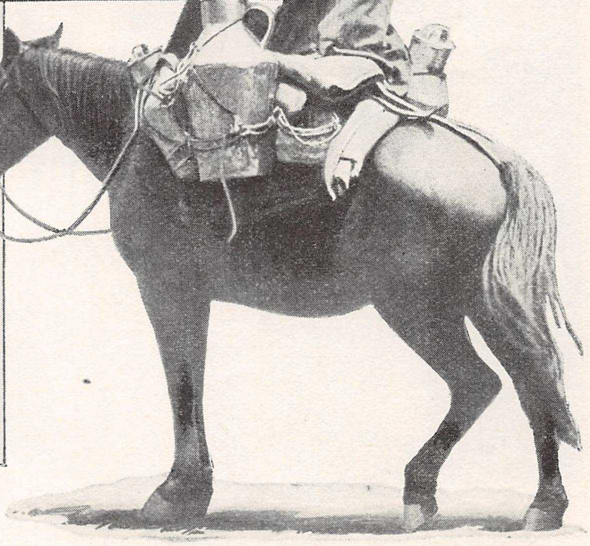


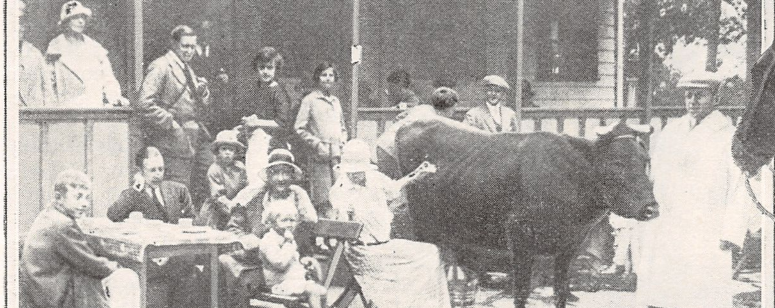
Bulgarian milkmaids balance their loads fore and aft as seen above, and in the better sections of Sofia they wear this quaint dress.



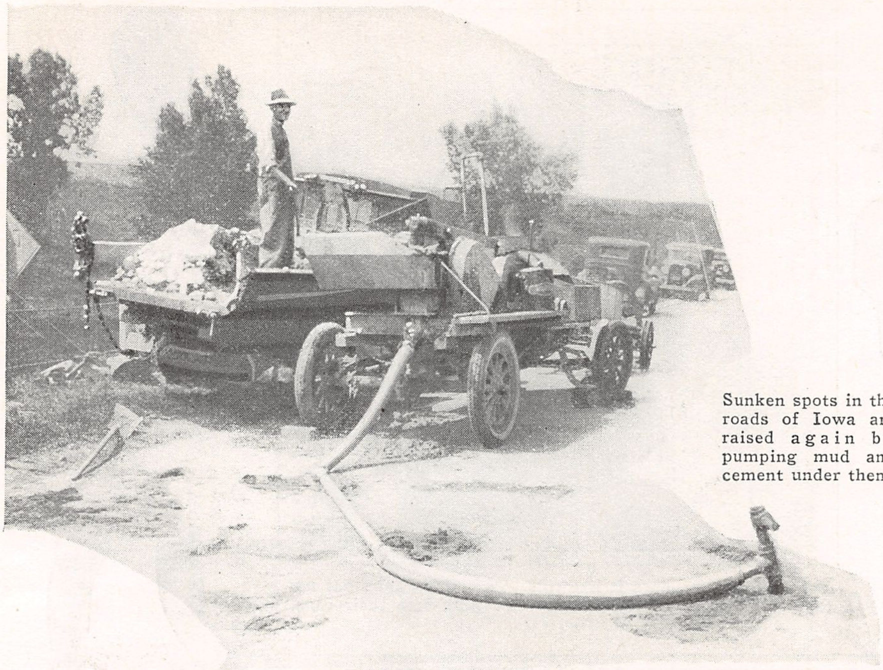
At left, the Macedonian milk boy is young but gallant and he stops in the streets of Uskub, Jugo-Slavia, to give his little friend a sip of breakfast.

Residents of Lima, Peru, get their milk brought to them on horseback as seen below. Note the shape of the cans and their size, indicating that a small load is carried.





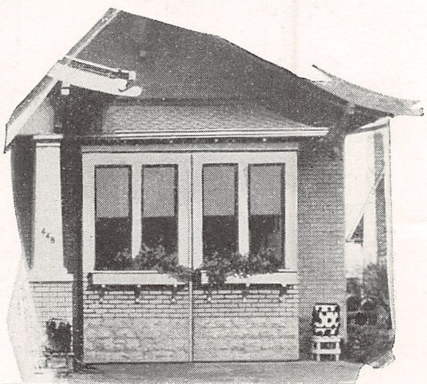
You are now viewing an Englishman's tea parlor at Le Touquet, France. The cow, one from a prize herd, is brought in and delivers the milk in person to the youthful consumers, one of whom is seen in the foreground.



Sunken spots in the roads of Iowa are raised again by pumping mud and cement under them.

FIRE STATION DISGUISED AS PRIVATE DWELLING

Property owners in an exclusive residential district of Portland, Ore., objected when underwriters offered them a choice between raised insurance rates or the building of a fire station. They declared the proposed fire station would be unsightly. But the fire chief solved the problem by erecting a structure that any passer-by would mistake for a private dwelling. Two camouflaged doors swing open to allow the engine to rush to a fire.

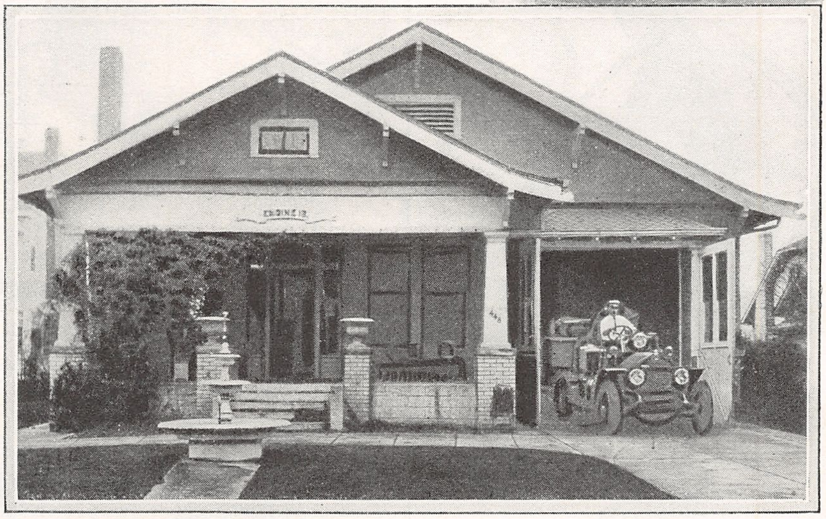


PUMP MUD TO RAISE ROAD'S SUNKEN SPOTS

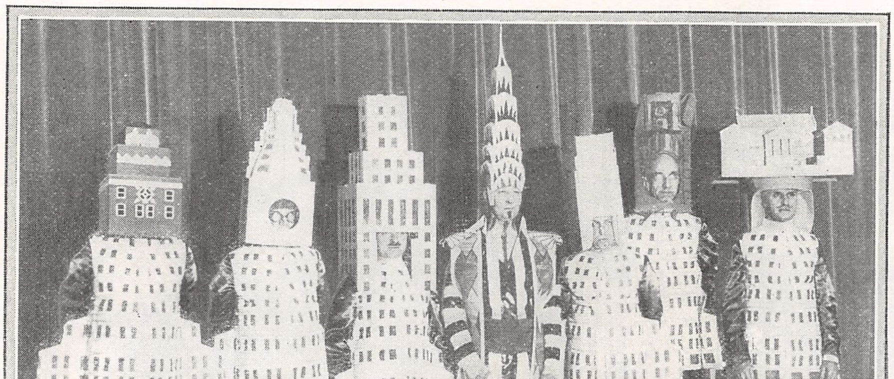
When concrete roads in Iowa settle, engineers of the State Highway Commission raise them by pumping mud and cement under the sunken parts. Holes are cut into the surfaces from twenty-four to thirty inches from the edges, from four to six feet apart. A similar row of holes is cut in the center of the roadway.

A gasoline-drive "mud pump," invented by John Poulter, Iowa highway engineer, forces the mixture through a hose into the holes. Mud alone would be sufficient to hold the road up, the engineers say, but cement is added to it to hasten the drying and reduce shrinkage. Thus sunken roads can be raised without re-laying their surfaces and interrupting the traffic passing over them.

To date 209 sunken spots have been raised by the new method.



Casual visitors to an exclusive residential district in Portland, Ore., would never guess that this is a fire station. Note, at top, how doors are made to look like part of the wall.



These are not real buildings; they are merely architects at play, each wearing a costume planned in imitation of a famous New York skyscraper that he had designed.

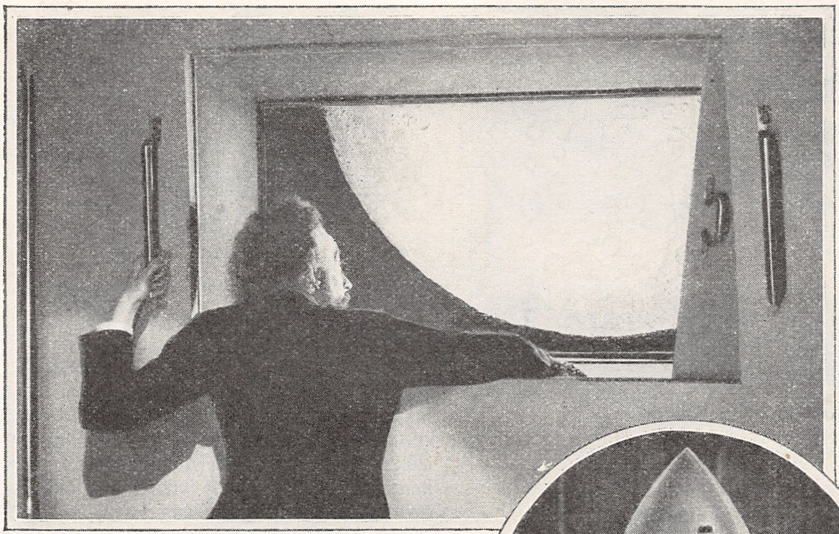
ARCHITECTS DANCE IN SKYSCRAPER COSTUMES

A group of famous architects formed a miniature "skyline of New York" when they met recently in costumes they had chosen for the annual Beaux Arts Ball in New York. Each of the novel costumes represented a building designed by the architect wearing it.

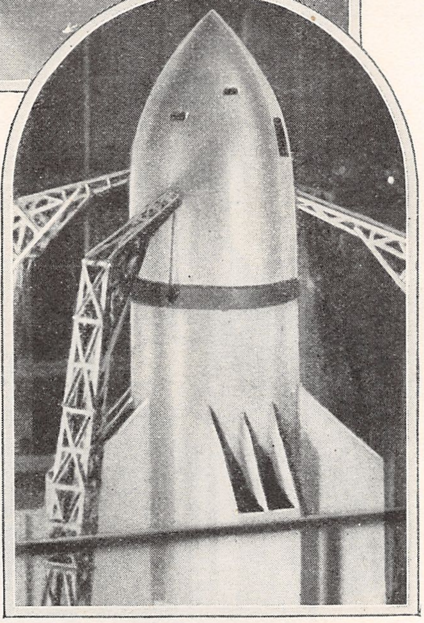
Lined up in the accompanying picture, starting at the left, are A. Stewart Walker, architect of the Fuller Building; Leonard Schultz, who designed the new Waldorf Astoria Building; and E. J. Kahn, architect of the Squibb Building.

Next, in the center of the group, with a regal air that befits his proud creation, stands William van Alen, architect of the Chrysler Building, still tallest of the world's completed structures. Then come Ralph Walker, representing the Wall Street Building; D. E. Ward, designer of the new Metropolitan Life Building, and at the extreme right J. H. Freedlander, who was the architect of the Museum of the City of New York.

FILM SHOWS ROCKET ON WAY TO MOON



Through the window of this imaginary gigantic rocket, the movie explorer sees the moon.



This is the mighty rocket that makes a flight to the moon in a recent sensational German moving picture exhibited in New York City.

A brilliant flash, an enormous puff of smoke, a whistling roar, and a giant projectile will begin its 480,000-mile round trip between the earth and the moon. That, as shown in a recent German movie, is what the start of a rocket's flight to earth's nearest neighbor would look like.

A huge rocket resembling an aerial bomb is represented as being fired into space, carrying passengers and crew. Doctor Esnault-Pelterie, French scientist, who lectured before the American Interplanetary Society in New York the other day on the possibility of just such a trip, used the German film to illustrate his discourse. He believes that a trip to the moon may be made before the end of the century.

EARTH RIPPLES JUST AS WATER DOES

Ripples pass over the earth's surface just as they do over a pond, scientists at the Harvard Seismographic Station have discovered. Similar quiverings, or "microseisms" have been noticed before, but always in volcanic areas, and never in this country up to this time. As most seismographs are not delicate enough to show these tiny earth waves distinctly, special apparatus was installed at the Harvard station for studying them. It is believed that much valuable scientific information might be obtained by observation of these waves from a continent-wide series of stations. Such an experiment, however, cannot be carried out at present because the cost of suitable instruments is too great.

STRANGE NEW ANIMAL FOUND IN AUSTRALIA

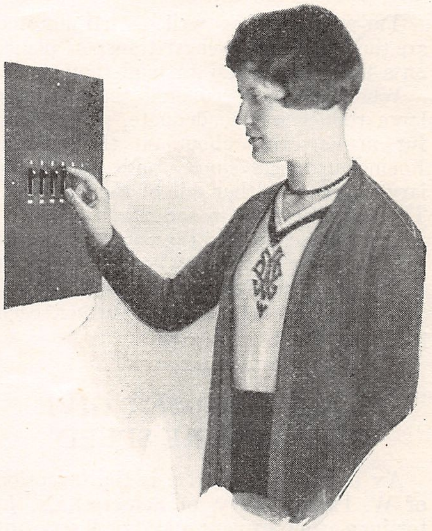
From the land of the kangaroo, wombat, and duck-billed platypus comes news of one more oddity. Recently Albert S. LeBoeuf, naturalist of Sydney, Australia, confirmed reports that a huge striped animal like a cat, but which carried its young in a pouch like a kangaroo's, has been seen in Queensland. "I am positive," he declared, "that Australia will present another zoological curiosity to the world."

NEW CIRCUIT BREAKER RIDS HOME OF FUSE

Patterned after giant devices used in power houses, a new miniature circuit breaker recently has been developed by the Westinghouse Electric and Manufacturing Company, for home use. This novel "safety valve" for household circuits is a switch that automatically trips itself as soon as current on its line gets too high for safety. It takes the place of fuses now ordinarily used for this purpose.

After it has broken the circuit, it may be reclosed by hand, without the loss of time occasioned when fuses are burned out. No service man need be called to put the circuit in operation again, and spare parts such as fuses do not have to be bought.

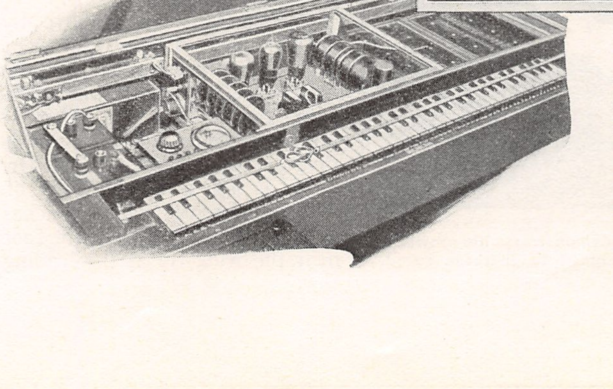
The panel containing the new circuit breakers is placed in some part of the house that is easy of access, such as the kitchen, or a hallway near it.



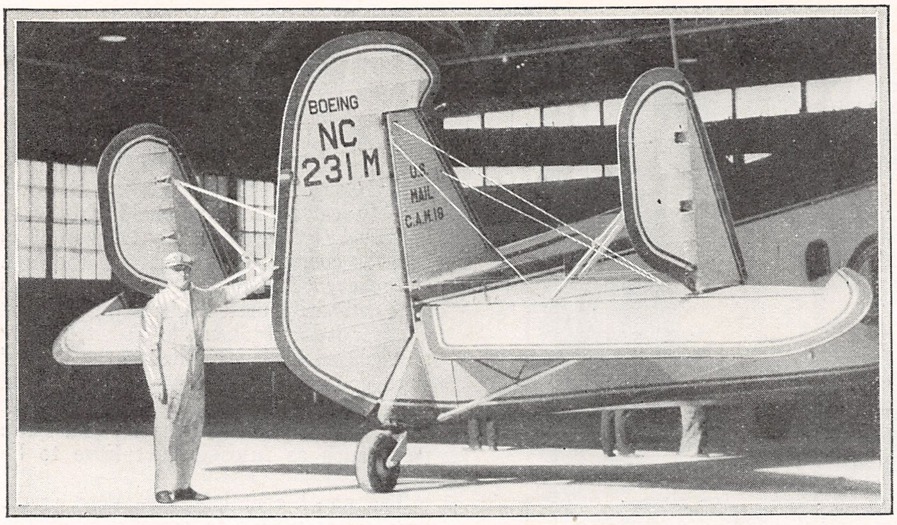
When the current on your light circuit gets too high for safety this switch trips itself.

THIS RADIO PIANO HAS NO STRINGS

Closely resembling a grand piano in appearance, a "radio piano," recently developed, has no hammers or strings. When a note on the keyboard is struck it actuates a corresponding radio tube, and a concealed loudspeaker emits a note of the proper pitch. The sound is like that of a wind instrument rather than a piano. A wire attached to one of the player's fingers modifies the volume at will.



Maurice Martenot, of Chicago, demonstrates the radio piano which he has invented. It has a regular keyboard but no strings or hammers. At left, the radio tubes that take the place of the strings are seen. As a key is struck a tube is actuated and the loudspeaker sounds the note, which is similar to that of a wind instrument.



USE THREE RUDDERS ON THREE-MOTORED PLANE

Tri-ruddered as well as tri-motored are the eighteen-passenger transport planes on a transcontinental air mail route.

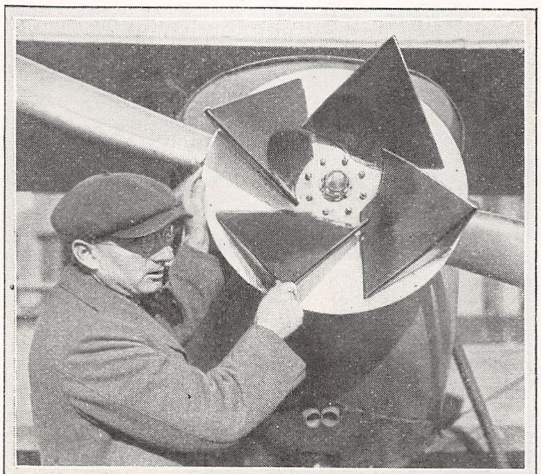
When it was discovered that a single large rudder was inadequate, particularly for maneuvering about on the ground, Boeing engineers simply added an auxiliary rudder on either side of the large one. They can be seen in the photo above.

The pilots now find the control surfaces ample. These are said to be the only craft in this country with triple rudders. Carrying out the triplet idea still further, each propeller has three blades.

VANES IN FRONT GIVE PLANE MORE SPEED

An odd-shaped device is the invention of W. Parker Perry, of Somerset, N. J., for increasing airplane speeds. A series of small vanes, looking something like paper pinwheels made by children, is mounted in front of the propeller hub. It is designed to create a partial vacuum before the machine, adding to its speed by decreasing the resistance.

On its first test flight at Roosevelt Field, N. Y., it is said to have increased the speed of a standard plane by ten miles an hour. The inventor says he got the idea for his device from the shape of a post hole drill on his farm.

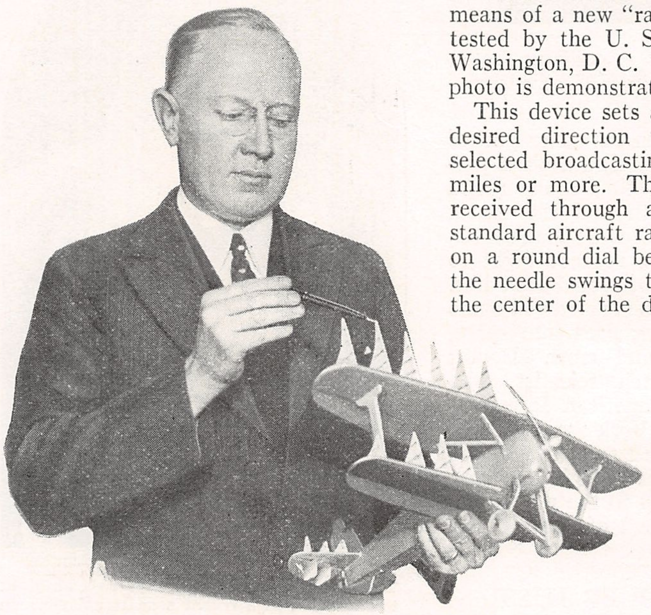


W. P. Perry, Somerset, N. J., demonstrates his pinwheel vanes on front of plane designed to increase speed.

BROADCAST STATION CAN GUIDE FLYER

Lost flyers soon may find their way in fog by following the strains of a jazz orchestra back home. In parts of the country where official radio beacon stations for aircraft do not yet exist, any broadcast station can guide a plane by means of a new "radio compass" recently tested by the U. S. Army Air Corps at Washington, D. C. The pilot in the above photo is demonstrating it.

This device sets a flyer's course in any desired direction with reference to a selected broadcasting station within 100 miles or more. The broadcast program, received through a set much like any standard aircraft radio, actuates a needle on a round dial beside the pilot. When the needle swings to the right or left of the center of the dial, it shows the pilot he is off his course. The device is intended not to replace, but to supplement regular aircraft radio beacon service. It was developed by G. G. Kruesi, technician of a western air line, in collaboration with Herbert Hoover, Jr., son of the President, and noted for his radio researches.



This model, exhibited by Dr. G. W. Lewis, director of research for the Committee for Aeronautics, shows points of strain during flight.

DARING FLIGHTS MEAN BETTER PLANES

Lighter, stronger, faster, and more maneuverable airplanes for the future were seen at the conclusion recently of experiments that were carried out during the last two years by the National Advisory Committee for Aeronautics. To illustrate the findings of these tests, which were conducted with fast fighting airplanes by three nationally known pilots at high speeds, the committee has built a scale model of a Boeing fighter showing the points on the wings and control surfaces at which highest pressures are reached in violent maneuvers such as outside loops and barrel rolls.

The model, shown above by Dr. George W. Lewis, director of aeronautical research for the committee, represents the pressures reached when a plane is pulled suddenly out of a power dive at 186 miles an hour. Dr. Lewis is indicating the point of highest pressure, which reaches about 450 pounds a square foot near the wing tip at the leading edge. It will also be seen that, near the wing tips, the pressure drops rapidly toward the trailing edge, but that as the center section is approached the pressure is more evenly distributed over the wing surface.

This determination of air pressures, which gives aircraft designers a basis on which to calculate points of structural strength, was made possible by the disregard of personal safety of test pilots employed by the N. A. C. A. to work out its flight problem in the air. One of these pilots, Major Luke Christopher, now secretary of the contest committee of the National Aeronautic Association, set a world record for acceleration in one of these routine tests.

The stresses imposed on various parts of the planes used in the tests were determined by the air pressure developed in small holes connected by aluminum tubes with a master recorder in the pilot's cockpit. The record was automatically registered on movie film at the moment of highest acceleration when the pilot pressed a button. The model shown was made from measurements taken from this film.

PUBLIC
TELEPHONE

SOUNDPROOF BOOTHS FOR AIRPORT PHONES

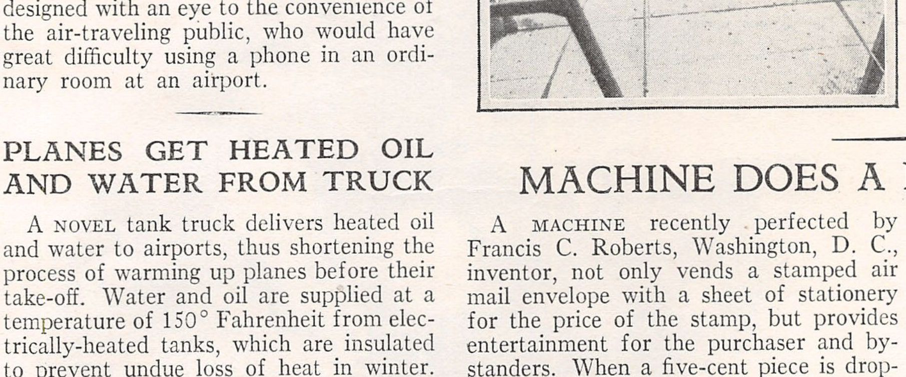
A novelty at an Oakland, Calif., airport is the set of soundproofed telephone booths that shut out the roar of near-by airplane engines from the ears of telephone users. Four booths are installed in one small building. The walls are insulated from each other as well as from airplane engine noises.

While telephones are not novelties at airports, this is believed to be the first time that their installation has been designed with an eye to the convenience of the air-traveling public, who would have great difficulty using a phone in an ordinary room at an airport.

PLANES GET HEATED OIL AND WATER FROM TRUCK

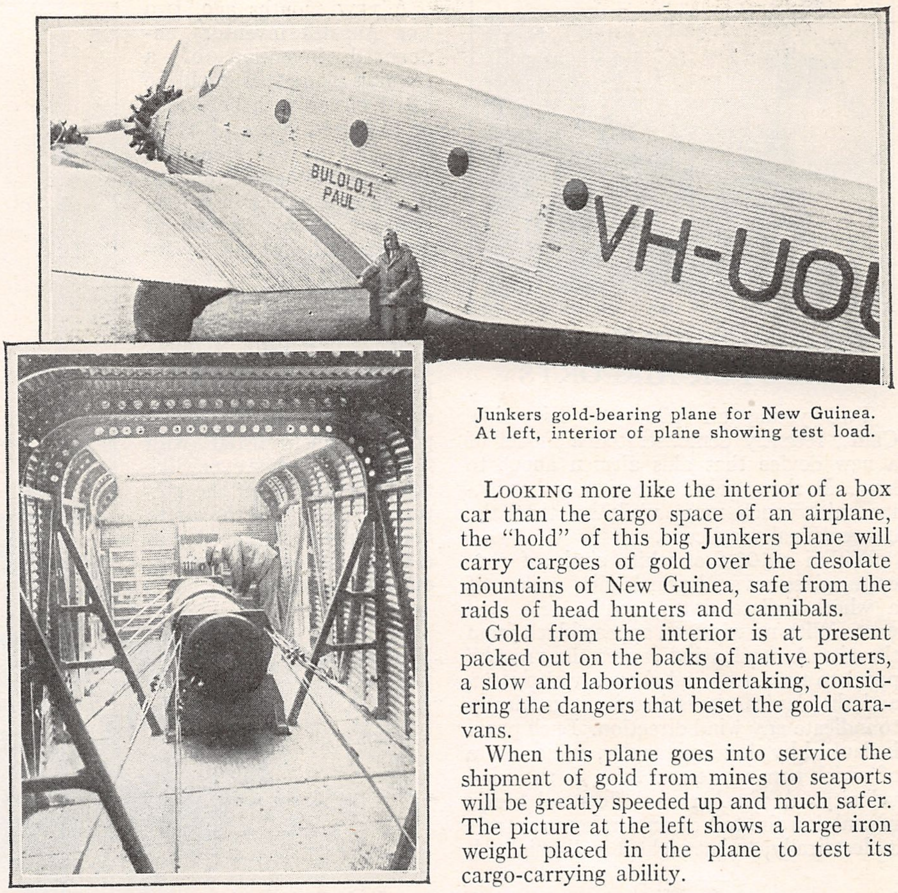
A novel tank truck delivers heated oil and water to airports, thus shortening the process of warming up planes before their take-off. Water and oil are supplied at a temperature of 150° Fahrenheit from electrically-heated tanks, which are insulated to prevent undue loss of heat in winter. The truck has recently been put into commission by a large oil and gasoline distributing company.

The heating is controlled automatically, insuring an even temperature of their contents. The truck also supplies gasoline to airports, delivering 500 gallons at one trip, as well as 100 gallons of oil and thirty-five gallons of water. The saving in time and fuel by delivering preheated supplies is so great that, it is said, the operation of the truck more than pays for itself.



Electric heaters warm the oil and water in this big tank so airplanes can save time used in warming up.

GOLD-BEARING PLANES BEAT SAVAGES



Junkers gold-bearing plane for New Guinea. At left, interior of plane showing test load.

Looking more like the interior of a box car than the cargo space of an airplane, the "hold" of this big Junkers plane will carry cargoes of gold over the desolate mountains of New Guinea, safe from the raids of head hunters and cannibals.

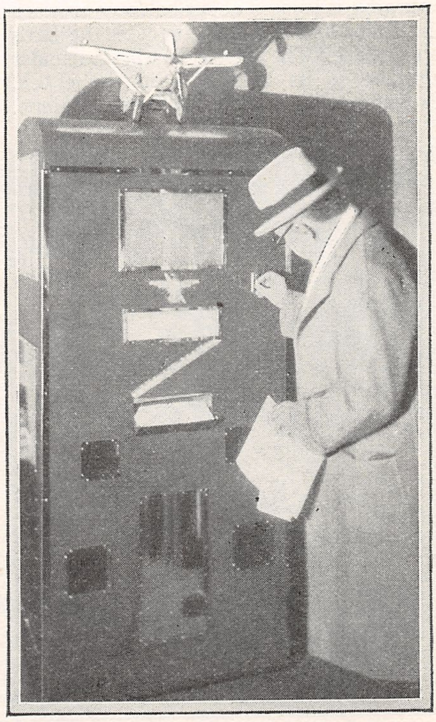
Gold from the interior is at present packed out on the backs of native porters, a slow and laborious undertaking, considering the dangers that beset the gold caravans.

When this plane goes into service the shipment of gold from mines to seaports will be greatly speeded up and much safer. The picture at the left shows a large iron weight placed in the plane to test its cargo-carrying ability.

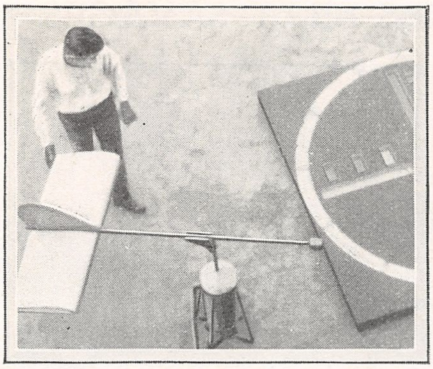
MACHINE DOES A LOT FOR A NICKEL

A machine recently perfected by Francis C. Roberts, Washington, D. C., inventor, not only vends a stamped air mail envelope with a sheet of stationery for the price of the stamp, but provides entertainment for the purchaser and bystanders. When a five-cent piece is dropped in the slot as shown at the right, the vending device comes to life and a number of things occur.

An air mail envelope with a sheet of paper is dropped from the slot in front, a motion picture showing air mail activities is begun on the screen above, an illuminated reel of advertisements starts moving through the smaller slot below it, and colored lights flash alternately in the four small apertures near the bottom. As if that were not enough for a nickel, a long mirror on the left side changes to a series of lighted red, white, and blue strips and the small airplane on top glows with light while its propeller revolves rapidly. The device has the endorsement of the Post Office Department.



Inventor operates his new machine which vends air mail stamp and does other things.



PILOTS INVENT WIND GAGE FOR AIRPORTS

Two young air pilots of Riverside, Calif., recently demonstrated a model of a new device that aids airmen about to land. It shows wind direction and velocity, with much more visibility than the conventional wind cone.

Within a 100-foot white circle of concrete, glass-covered panels like spokes of a wheel radiate north, south, east, and west. With no wind, all appear black from the air. A north wind causes the "north" panel to turn over and show a white strip, and the device alters itself automatically to indicate any wind direction. Each panel is flanked by three rectangles, one or more of which turn white according to the wind velocity. A weather vane "control head" resembling the tail of an airplane controls it electrically, and at night it is illuminated.

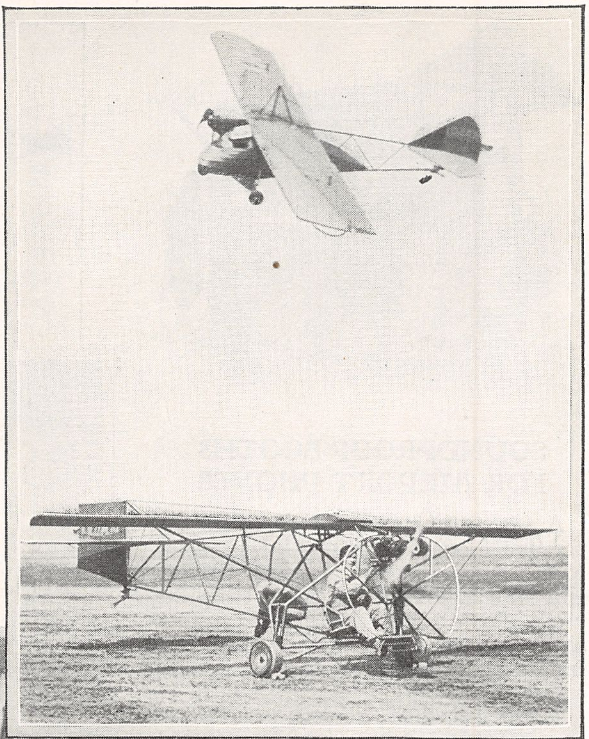
LEVER JACK RAISES PLANE OFF WHEELS

An airplane jack developed recently by United States Army Air Corps engineers at Crissy Field, San Francisco, Calif., is a lever that "pries" planes up so work can be done on their tires. It consists of a wooden bar thirteen feet long with a heavy roller fitted a foot from one end. A chock or groove is located about halfway between the roller and the short end on the bar's upper face. The device is wheeled under a plane so its axle rests in the chock. Pressure on the long end raises the plane.

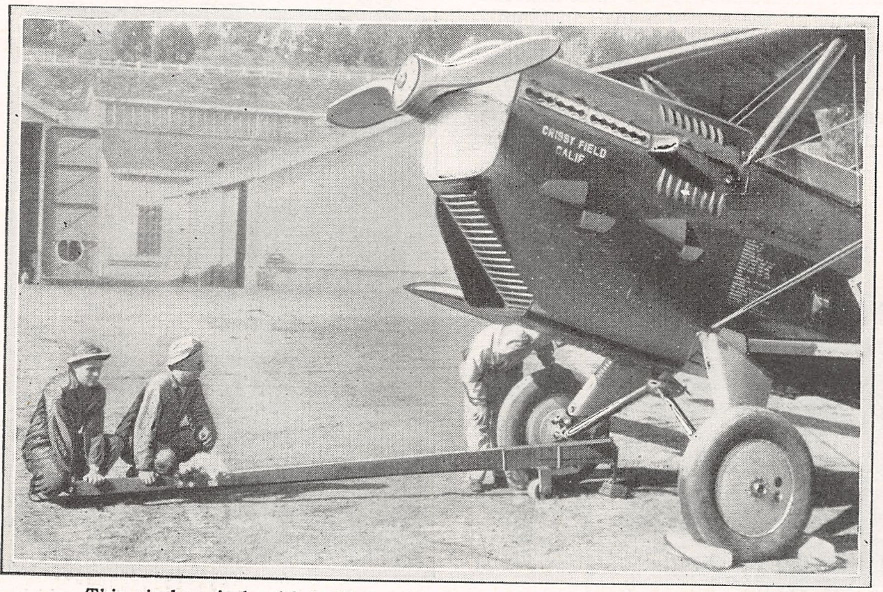
CHANGING WINGS MAKES PLANE FLY

A few months ago, two Los Angeles inventors announced invention of a training plane that could be fitted either with "clipped" or full-sized wings (P.S.M., Oct. '30, p. 56). Here is a striking photograph of two of the odd planes in action, snapped during a recent demonstration of the "cycloplanes" at Los Angeles.

The lower craft in the picture at right gives the student his first flight training. It cannot leave the ground, but answers its controls in every other way like a real plane. When fitted with longer wings, however, like the upper plane in the picture, it soars into the air to give a more advanced student an opportunity to try out his experience.



WESTERN AIR EXPRES



This airplane jack with a thirteen-foot wooden lever and a roller block will easily raise a big plane off its wheels so that work can be done on the tires.

THREE MAIL PILOTS FLY 2,400,000 MILES

A piece of string tied around a globe is a symbol to air mail flyers Jimmy Carson, Fred Kelly, and Jimmy James, seen in the picture above. It represents flight equal to the circumference of the earth while carrying Uncle Sam's mails. These aerial postmen, nicknamed the "three musketeers of the air," already have tied their one-hundredth string around the globe, signifying 2,400,000 miles of flight.

Their run is with the eastbound mail from Los Angeles to Salt Lake City. They started on it April 17, 1926, and are still flying it. In making this record they have flown nine ships, each of which is still equipped with its original motor. The total mileage of their flights more than equals four and a half complete round trips between the earth and the moon. During the time they have established this record they have had no serious accidents, although they have flown in all kinds of weather.

An abalone fishing crew. Note the diver on ladder walking into sea.

Find Riches in Mysterious Ocean Shells

By JOHN E. LODGE

The pendant on this necklace, one of the largest ever found, is worth $1,000.

WALKING on the bed of the sea, sixty to one hundred feet beneath the surface, men armed with steel bars, long knives, and small net baskets each year bring up from a limited area on the coast of California approximately 120 tons of rainbow-colored shells, worth $4,000 to $5,000 a ton. These shells contain a little more than 3,000,000 pounds of sea food, and in addition every now and then a fine pink or gray pearl, valued at $50 to $1,000.

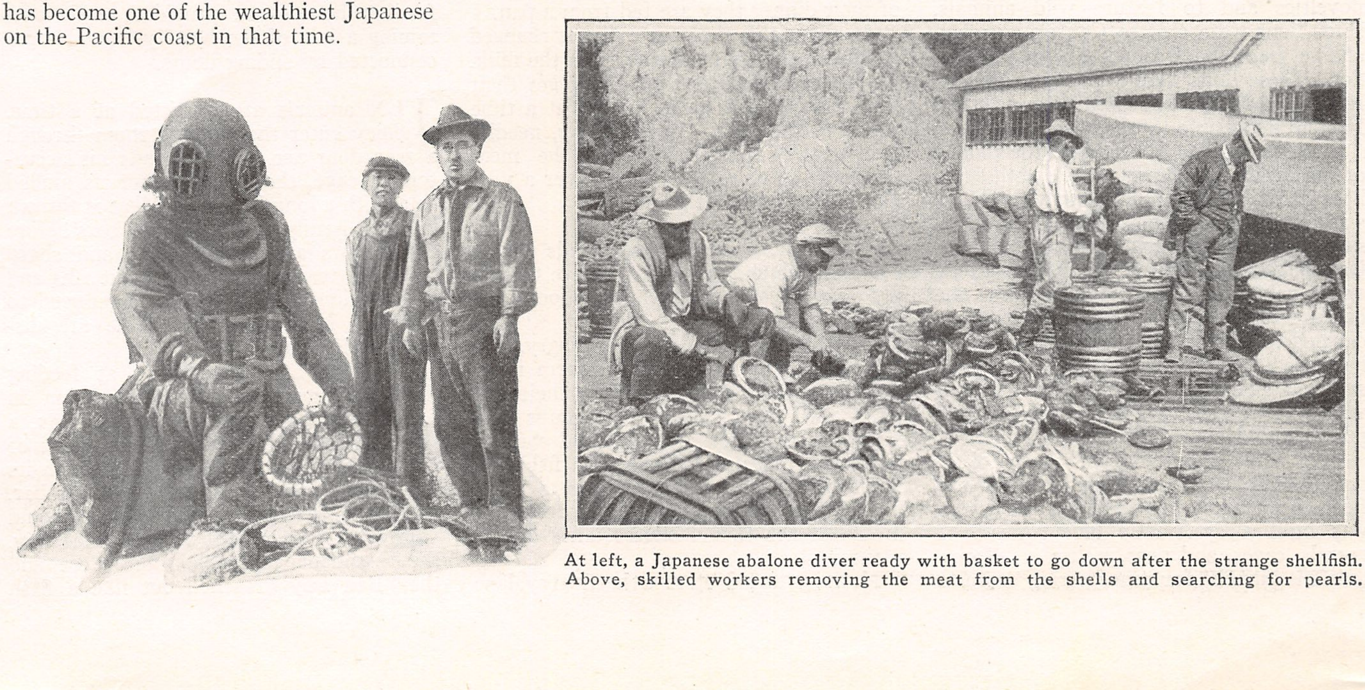
These men are abalone hunters, and the shell they find is made into costume jewelry that has a ready market in the United States, continental Europe, and the interior of Asia. Rings, necklaces, ear pendants, and bracelets are made from the gray, green, pink, lilac, and black shell, while the larger pearls go into the jewel collections of the world.

The fishermen, mostly Japanese employed and directed by Americans, are the highest paid workers in their craft in the world, receiving $25 a day for five hours' work during a season covering eight to nine months of the year. One of them is a woman, who has been doing this work for more than ten years, and has become one of the wealthiest Japanese on the Pacific coast in that time.

The abalone fisheries are at Monterey, Calif., and Ensenada, in the Mexican territory of Lower California, about eighty miles south of the United States border. The fishing is done ten to twelve miles out at sea.

THE abalone is a univalve (one-sided shell) that clings to rocks, gravel bottom, kelp roots, and ledges. Minimum size which may be taken legally is eight inches in diameter, but some have been brought up more than twice this size.

This queer fishing is done from twenty-foot boats—large, heavily-built skiffs towed to the scene of the fishing by sixty-foot motorboats. Arrived at the rocky reefs and under-surface islets where the abalone *(Continued on page 142)*



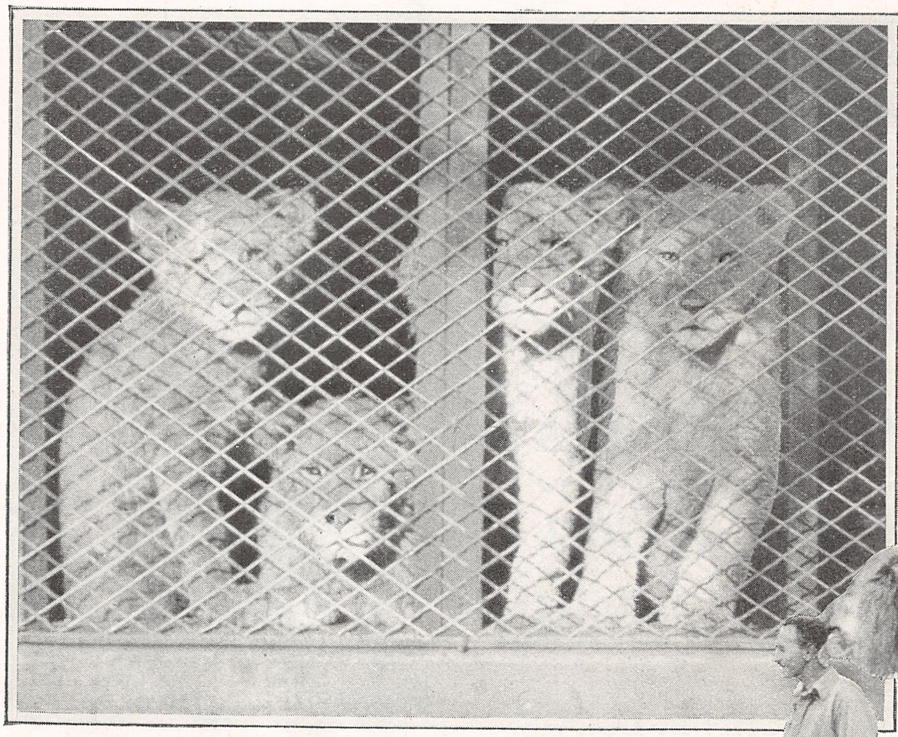
At left, a Japanese abalone diver ready with basket to go down after the strange shellfish. Above, skilled workers removing the meat from the shells and searching for pearls.

How I Breed Lions

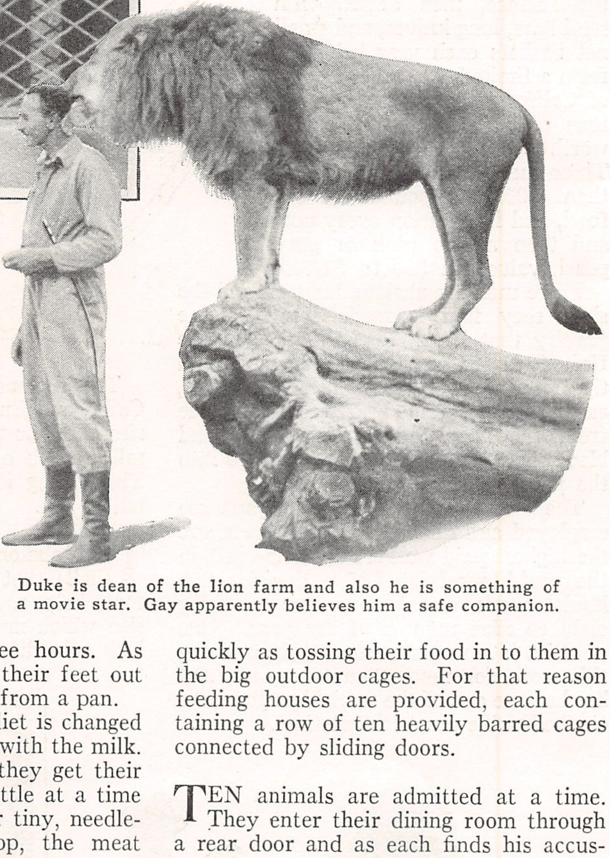
Methods used on only farm in the world where Africa's King of Beasts is raised are described here. After ten years 178 lions live on ranch, and they have made a fortune for their trainer.

By CHARLES GAY

As Told to TOM WHITE



Behind the wires on the only African lion farm in the world at El Monte, Calif. These youngsters, eight months old, will grow for six more years.



Duke is dean of the lion farm and also he is something of a movie star. Gay apparently believes him a safe companion.

ON THE outskirts of El Monte, Calif., I have a stock farm—a five-acre tract given over entirely to raising lions. This strange enterprise, now a flourishing business, has the distinction of being the only African lion farm in the world.

On a dark night at my farm when the beasts are restless, it is not difficult to imagine one's self in the heart of the jungle. One animal will begin roaring and straightway the rest will take up the cry—a low-pitched, throaty bellow that swells, reverberates, and dies away in a single resonant note.

Ten years ago, when Hollywood motion picture producers began to reach out for novelties and to feature wild animals, three lions were sent to California in my charge from the Bostock Shows of London. These lions were known as Cyclone, Rosie, and Mary. Shortly after my arrival I found it possible to purchase this trio.

Rosie proceeded to celebrate the change of ownership by presenting me with three brand-new lions, and not long after Mary was equally generous. In fact, lions swarmed on me in such numbers that Mrs. Gay had to come to my aid. It was a new and thrilling experience for her, but she became so enthusiastic about it that she decided to have a farm where lions could be raised to supply the world's demand and could be trained for the movies and where from the very start the visiting public would help defray the expenses.

Five acres were selected at the little town of El Monte, and we laid out the farm to include a great stockade in which was built a systematic arrangement of corrals, cages, and pens with a novel system of tunnels for transferring animals from inclosures to cages. Today, we have 178 big cats, ranging from day-old bottle-fed babies to fully-matured beasts of both sexes.

Horses, goats, and chickens, which go to make up the food of the lions, are also quartered on the farm. Twelve goats and one cow are kept to provide milk for the babies. At first, the fuzzy little cubs are fed from the bottle every three hours. As soon as they learn to keep their feet out of their dinner they are fed from a pan.

At about this time their diet is changed to include an egg beaten up with the milk. At the age of eight weeks they get their first taste of raw meat, a little at a time added to the milk. As their tiny, needle-like teeth begin to develop, the meat allowance is increased. Lions over a year old are fed raw horse meat.

ADULT lions eat sixteen pounds once a day, which means that I have to supply eighteen hundred pounds of food each day.

Healthy lions are always hungry, but the surest way to get rid of them is by overfeeding. In order to supply their systems with the necessary vitamins and minerals, the meat is sprinkled with a powdered mixture of kelp and fishbone. Each lion is fed separately in a cage. Transfer from the yards and corrals by means of the tunnel chutes takes only a few minutes.

Nothing would start a battle royal so quickly as tossing their food in to them in the big outdoor cages. For that reason feeding houses are provided, each containing a row of ten heavily barred cages connected by sliding doors.

TEN animals are admitted at a time. They enter their dining room through a rear door and as each finds his accustomed cage the sliding door is pulled shut with a long iron rod. Meat is thrown in and it hardly passes the cage bars before huge claws are sunk into it and sharp teeth are tearing it apart. Stout ribs and half sections of vertebrae are reduced to crumbs. Meat and bone alike are dispatched in short order.

We have all learned that at feeding time we must use extra precaution in handling the big cats. Some time ago, a two-year-old cub developed the habit of lying in its cage at feeding time with its paws hanging out below the base crossbar. At the approach of an attendant it would vainly try to get hold of him. One day, the attendant approached too close and the "Bad Boy" reached out like a flash

At the age of three, these cubs have become real lions. They will reach full growth in four more years.

with one of its big fan-shaped paws, claws unsheathed, and hooked the man's hand, pulling it to the bars for further punishment with its daggerlike fangs. The keeper freed himself before his hand was crushed, although a painful wound was the result. Many raps on the knuckles since then have taught that lion to keep its paws inside.

Bad Boy is one of the few lions we have that can't be trusted.

Like humans, the big cats have temperaments and individuality. One may be ever ready to pick a fight; another, of a retiring disposition. Some are vicious, resentful; others playful, affectionate. It is an axiom among us that the first thing to do is to know your lion—if you can!

One of the most essential qualities of a successful trainer, in my opinion, is confidence—both in himself and his subject. It is a mistaken idea to suppose that a lion can be trained by sheer brutality. To make him realize that his trainer is master requires firmness backed up if necessary by punishment in the shape of solitary confinement, which deprives him of the privilege of running loose in the big arenas and sunning himself, of both of which he is extremely fond. It is therefore unwise and unnecessary to use guns and clubs.

When I enter a lion cage I carry a .45-caliber six-shooter loaded with tear gas shells, the use of which is effective and in no way brutal. I have not yet needed to use this revolver, although I have had some narrow escapes from permanent injury. Such encounters, though, invariably result from some little carelessness that should have been avoided.

For instance, one day a playful two-year-old lion pawed at my shoe. One of its claws caught in an eyelet. The young lion, becoming frantic with fear, grabbed the shoe in its jaws and severely crushed my foot. This was a painful lesson from which I learned that one should never wear shoes with eyelets when visiting the lion's den.

How does the successful trainer know when it is time to get out of the cage? He doesn't know; he senses it. Some deeply hidden faculty, developed only through long contact with the big cats, tells him when to leave. Aside from that, there is a definite means of gaging a lion's state of mind. His eyes tell you.

When the pupil is just a tiny black point against the green, he is at rest, peaceful, contented, happy. As he becomes excited or aroused, the iris dilates. When pained, fully aroused, or about to charge, the pupil reaches almost from the upper to the lower lid.

Even when they are trained, lions are in no sense trick animals. Their nature and general demeanor stand in the way of their becoming highly successful performers. However, in my band of animals there are several that are famous all over the world for their movie stunts. Numa, a black-maned Abyssinian male that was added to the band during the second year, has earned more than $70,000 as an animal actor in moving pictures. He has "stolen" many pictures with his businesslike method of doing what is required of him.

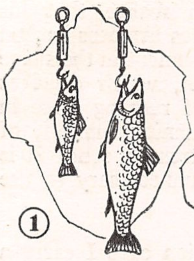
The runner-up for popularity is Leo, trademark of one of the big producing companies. His mighty head is daily seen by world-wide audiences as he flashes on the screen to roar a welcome in pantomime.

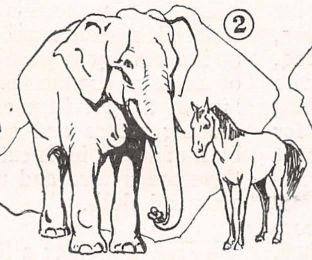
Thus far, my trained lions have brought in the bulk of revenue while the daily attendance of visitors at the farm more than pays expenses. It has taken ten years to get the breeding stock in proper shape for disposal, and even now we are not quite ready to unload our product, although we have on file scores of orders from zoological parks and circuses in many parts of the world.

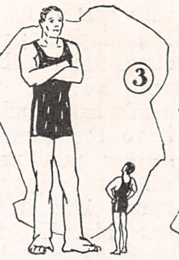
One of the strangest offers we ever had came from a Chinese doctor who offered a dollar apiece for lion whiskers with which to concoct a mysterious remedy for human *(Continued on page 148)*

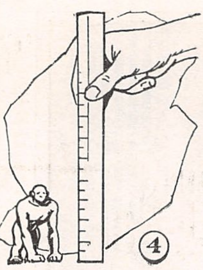
Finding a convenient stump, this serious faced cub carelessly hangs himself out for a good sun bath.

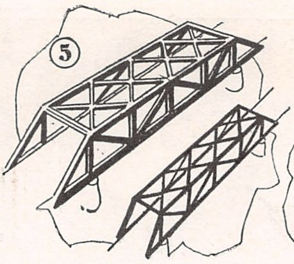
Not infrequently the lioness will desert her cubs and in that case bottle feeding is necessary if the youngsters are to survive. Here Mrs. Gay is attending to the insistent demands of a little fellow who is only eight days old. In seven weeks he will eat his first meat.

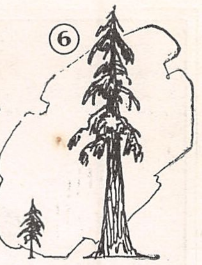












Why Can't Men Become Giants or Jump Like Grasshoppers?

This Article Gives You One Simple Rule That Answers Many Baffling Problems

By GAYLORD JOHNSON

1 Why does a fish's weight increase eight times while it grows to only double its length?

2 Why are an elephant's legs so much thicker in proportion to his size than a horse's?

3 Why do men never grow to be eighteen feet tall?

4 Why would men, if on the planet Jupiter, be midgets only a few inches high?

5 Why would a steel bridge 150 feet long (built in exactly similar proportions to one seventy-five feet long) be comparatively much weaker?

6 Why is a 150-foot pine tree thicker at its base (in proportion to its height) than a thirty-foot tree of the same species?

7 Why do whales sometimes grow to be 100 feet long?

8 Why can a mouse fall down a mine shaft and be merely stunned, while a man is killed and horribly mangled?

9 Why can a humming bird stand still in the air over a flower, while an eagle must run along the ground before it can rise from the ground at all?

10 Why is it impossible for a man to fly by means of wings propelled by his own muscular power?

11 Why can a grasshopper jump dozens of times its own height, while a man can rarely leap over a shoulder-high fence?

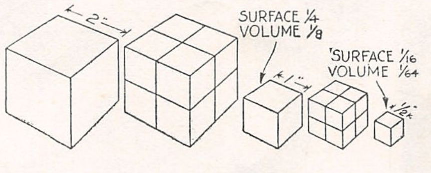
12 Why would skyscrapers like the Chrysler and Empire State buildings be impossible without steel?

THE mechanical principle that clears up all of the questions asked in the column at the left is contained in any cubic block of wood—yet they will puzzle nine out of ten men who lack engineering training.

To find this principle, understand it, and use it, we need nothing but the block and a handsaw. And, if we like, we can *imagine* both block and saw.

Take your cube and saw (either real or imaginary) and use them to discover this fundamental law of mechanics, in the same way that Galileo did away back in the seventeenth century. Then you can solve any problems like these with common sense and common arithmetic.

You may as well follow Galileo's own directions, word for word, for he wrote them down in a book, which, by the way, for the first time in history explained mechanics as an orderly science.



"Take," says Galileo, "a cube two inches on a side so that each face has an area of four square inches and the total area, i.e., the sum of the six faces, amounts to twenty-four square inches; now imagine this cube to be sawed through three times so as to divide it into eight smaller cubes, each one inch on the side, each face one inch square, and the total surface of each cube six square inches instead of twenty-four as in the case of the larger cube.

"It is evident therefore that the surface of the little cube is only one fourth that of the larger, namely, the ratio of six to twenty-four; but the volume of the solid cube itself is only one eighth; the volume, and hence also the weight, diminishes therefore much more rapidly than the surface. If we again divide the little cube into eight others we shall have, for the total surface of one of these, one and one half square inches, which is one sixteenth of the surface of the original cube; but its volume is only one sixty-fourth part.

Volume Diminishes Faster than Surface

"Thus, by two divisions, you see that the volume is diminished four times as much as the surface. And, if the subdivision be continued until the original solid be reduced to a fine powder, we shall find that the weight of one of these smallest particles has diminished hundreds and hundreds of times as much as its surface. *And this I have illustrated in the case of cubes holds also in the case of all similar solids.*"

Galileo did not put these last words in italics, but I have, for they contain the key to the first of our problems. A six-inch black bass and the same fish when grown to twelve inches are "similar solids." Our law of mechanics applies equally to these two sizes of fish and to any two sizes of Galileo's cubes.

In fact, we may, if we choose, assume that each fish is made up of many tiny cubes, as suggested in the diagram on the opposite page.

Let us take an imaginary knife, cut up the six-inch fish into imaginary cubes, and count them. We can of course suppose our cubes to be small enough to be included in the thickness of the fins, but for convenience in figuring we will disregard all the fins and make our cubes one eighth inch on each side. The volume of each cube will therefore be one five hundred

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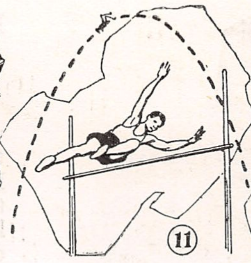

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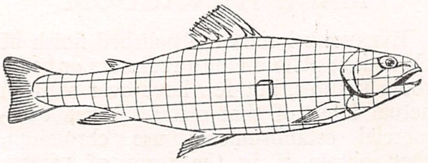
and twelfth of a cubic inch. Assuming the fish's volume to be fourteen cubic inches, it will contain 7,168 cubes.

Any growth in size which we imagine for any *one* of these 7,168 cubes must happen equally to *all,* and the growth in size of the fish will be the sum total of the growths of all the little cubes it contains.



Volume of Fish Varies As Cube of Its Length

Let us fancy that the cube outlined in the diagram has grown gradually from one eighth inch to one fourth inch on each side. We know from Galileo's illustration that in doing so it has increased its volume eight times—from one five hundred and twelfth to one sixty-fourth of a cubic inch. Is it not plain at once that the entire fish (still composed of 7,168 cubes) has also increased its volume eight times? We have therefore proved by cutting up the fish into tiny cubes, or dice, and watching each cube grow, that *the volume of the fish varies as the cube of its length, since this is the rule that holds true for each of its tiny cubic components.*

There is an application of this rule which, if you know it, will enable you to surprise a friend by the accuracy with which you can "guess" the weight of a fish. You need only know the weight of some particular length of the *same kind* of fish.

If you know, for instance, that a six-inch bass weighs half a pound, or eight ounces, you can "weigh" a twelve-inch bass by simply measuring it! Here is how it works: The weight (volume) varies with the cube of the length. This being true, the weights of any and all sizes of the same variety of fish, when divided by the cubes of their lengths, will always yield approximately the same number. If you know this constant figure for a six-inch bass, you can find the weight of a twelve-inch one simply by multiplying the cube of twelve by this constant figure.

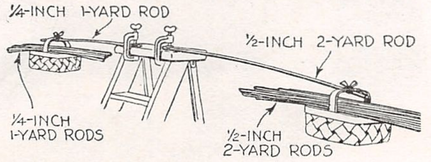
How much does a six-inch bass weigh? We have said half a pound. Then eight ounces divided by the cube of six, or 216, will give us our constant figure. It works out to be .037. This fraction, when multiplied by the cube of twelve, or 1,728, gives about four pounds—the weight of the twelve-inch bass.

The problems about the great thickness of elephant's legs, the impossibility of human giants, the stature of men on Jupiter, the comparative weakness of a large bridge proportioned like a smaller one, and the greater relative thickness of larger trees can all be explained by the results of the following simple experiment, suggested by Galileo. A reference to the diagram below will help to make the experiment plain at a glance.

The materials required are a supply of square rods of two sizes. One size is one fourth inch square and a yard long. The other is one half inch square and two yards long. One is just twice the dimensions of the other. We shall also need two baskets exactly alike in size and weight, a couple of small iron clamps, and a stepladder.

Two of these rods (one of one fourth inch size, the other one half inch) are firmly clamped to the top step of a stepladder, projecting in opposite directions, as shown in the diagram below. The basket handles should be tied to the ends of the rods, to prevent them slipping off.

The purpose now is to find the number of one-fourth-inch one-yard rods that can be put into the basket supported upon the one-fourth-inch one-yard rod, and how many one-half-inch two-yard rods can be added to the basket hanging from the one-half-inch two-yard rod, before each of the rods breaks under its load.



Let us try to predict the result, using the rule we learned from Galileo's cubes and applied to the two fish: "The area increases with the square of the linear dimensions; while the volume (or weight) increases with their cube."

Cross Section Determines Resistance

In the case of these two supporting rods, we are interested only in the areas of their *cross sections,* for these determine their comparative resistance to breakage. The square of the one fourth inch diameter rod is one sixteenth square inch. That of the one half inch diameter rod is one fourth square inch. The one-half-inch rod is therefore four times as strong, will support four times the weight before breaking that the smaller one will.

But the volumes (or weights) of the two sizes of rods are to each other as the cubes of their diameters. The yard-long rod is made up of 144 one-fourth-inch cubes; the two-yard rod contains an equal number of one-half-inch cubes. One of the one-half-inch rods therefore weighs eight times as much as one of the one-fourth-inch ones.

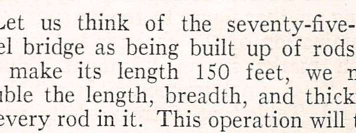
What will eventually happen if we progressively add one rod at a time to each basket? It is easy to predict. Since the larger rod is eight times heavier and only four times stronger, *it will support far fewer of its own kind without breaking than the smaller rod will.*

If the one-half-inch rods weigh six ounces each and the one supporting the basket breaks when ninety of them have been placed in it, we know that it will resist a weight of thirty-three and three fourths pounds. But the one-fourth-inch rod is only one fourth as strong. If we continue adding rods to the ninety already in the basket it supports, how many will be in it when the support finally gives way? Obviously, it will break when the weight equals one fourth of thirty-three and three fourth pounds, or about eight and seven sixteenths pounds. And since each one-fourth-inch rod weighs one eighth of six ounces, or three fourths of an ounce, we can add ninety more one-fourth-inch rods to the basket, making 180 in all, before the one-fourth-inch supporting rod breaks.

Why 150-Foot Bridge Is Weak

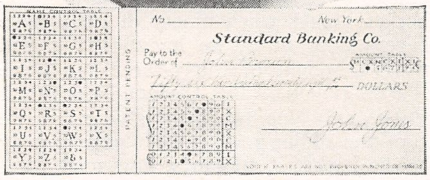
Let us think of the seventy-five-foot steel bridge as being built up of rods. If we make its length 150 feet, we must double the length, breadth, and thickness of every rod in it. This operation will then of course multiply the bridge's total weight eight times, and increase its ability to support loads only four times. The larger bridge of similar proportions is obviously unable to carry twice the maximum load of the smaller, for part of its strength is already being used to support its own greatly increased weight. This also explains why bridges and tall buildings are built with I-beams and other shapes that give maximum strength in proportion to weight.

Suppose a man six feet high weighs 175 pounds. At eighteen feet high he would weigh twenty-seven times that—or nearly two and three eighths tons if all other dimensions were increased in the same proportion. If the thigh bone, or *femur,* of a normal-sized man is assumed to be one and one half inches in diameter, the same bone in a giant such as we have imagined would need to be nearly eight inches thick, while its length has increased only three times!



The two bones shown above are from a sketch made by Galileo to illustrate his explanation of this point. He says in conclusion, "You can see how out of proportion the enlarged bone appears. Clearly then if one wishes to maintain in a great giant the same proportion of limb as that found in an ordinary man he must either find a harder

(Continued on page 144)



NAME CONTROL TABLE

PATENT PENDING

No ______ New York ______

Standard Banking Co.

Pay to the Order of John Brown $

DOLLARS

AMOUNT TABLE

AMOUNT CONTROL TABLE

John Jones

NEW CHECK DESIGNED TO PREVENT FORGERY

No bulky "check protector" is needed to guard against fraudulent check-raising, with a new printed form designed by M. Pnagouni, of Brooklyn, N. Y.

After the check is written in the usual way, three places are punched, two of them safeguarding the amount and one the signature. A punch mark in an "Amount Table," at upper right, prevents adding another figure to the amount. The denomination of the check is indicated in punch marks in an "Amount Control Table." A final protection is a "Name Control Table" at extreme left, where numbers are punched according to the number of times each letter appears in the signer's name.

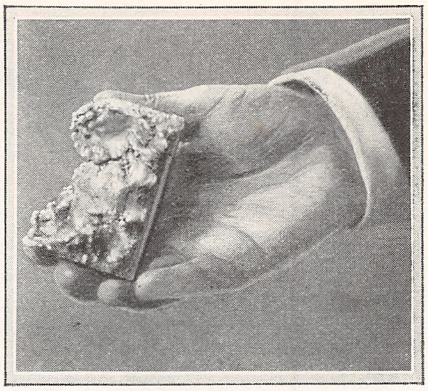
In the photograph above, the inventor demonstrates how the check is punched.

DOUBLE KEYBOARD PIANO PERMITS NOVEL EFFECTS

A piano with two keyboards recently was perfected by Hans Barth, piano virtuoso, who used it on a concert tour he has just completed that took him from the Atlantic to the Pacific coast. Its upper keyboard is tuned the same as that of an ordinary instrument, but the lower one is pitched a quarter of a note lower. The quarter-tone keys permit new and unusual harmonies, such as those of Chinese and other Oriental music employing the quarter-tone scale. There are fourteen white and ten black keys to an octave, instead of seven white and five black.

The inventor, seen seated at the end of the piano in the picture below, is shown demonstrating his new piano to George Gershwin, noted pianist and composer. This instrument is intended for concert use only and naturally will not replace the single keyboard pianos now used in homes. Not every pianist would be able to play Barth's piano.

Hans Barth, rear, shows his new quarter-tone piano to George Gershwin, who finds unusual harmonies on it.



DISTILLED CHROMIUM MADE IN VACUUM

Everyone knows the polished finish of chromium plate on auto radiators or bathroom fixtures, but few have ever seen an actual lump of that metal. When commercial establishments use chromium, they obtain it in the form of "ferrochrome"—a grayish alloy with iron.

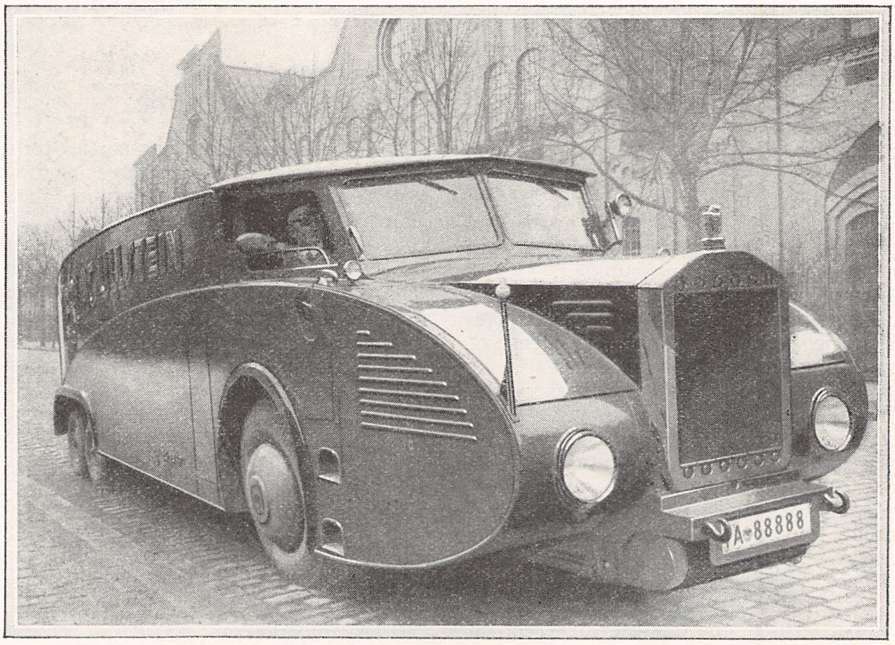
Recently, however, experts of the Westinghouse Research Laboratories at East Pittsburgh, Pa., exhibited a lump of the pure metal as big as one's fist. It was the world's first specimen of distilled chromium, and was made in an almost perfect vacuum.

AUTO SAFE IN EARTHQUAKE

Automobiles are earthquake-proof, says Doctor T. A. Jaggar, American volcano expert. Recently while driving in one of the Hawaiian Islands he passed through a district that was experiencing a severe shock. He did not know about it until informed afterwards.

BIG CAR RUSHES PAPERS TO STANDS

Residents of Berlin, Germany, find their newspapers now appear a few minutes earlier on the news stands. A huge streamlined truck whizzes through Berlin streets to outlying districts of the city at fifty miles an hour. Within it are bundles of newspapers for stands along the route. The odd 100-horsepower car is one distributor's answer to rivalry in getting the papers on the streets first.

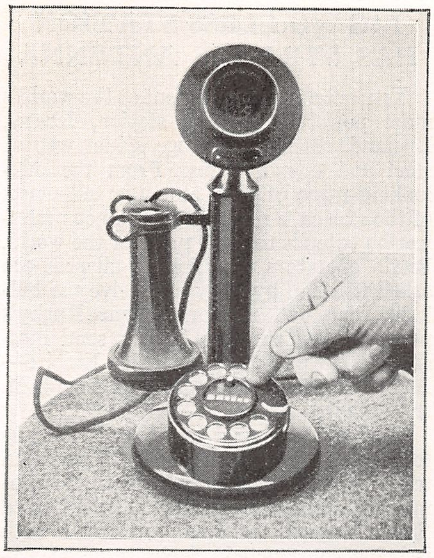


Competition among newspaper distributors in Berlin, Germany, led to the production of this 100-horsepower, streamlined car which rushes the papers to the news stands.

THIRTY-ONE BIG TICKER SYSTEMS KEPT BUSY

Everyone is familiar with the stock ticker of commerce, but not everyone knows, according to Western Union officials, that this telegraph concern alone operates thirty-one kinds of tickers.

Sport news goes out over one great ticker network. Marine news is an important ticker service described recently in this magazine (P. S. M., Jan. '31, p. 22). Individual ticker circuits report the prices of commodities such as cotton, grain, rubber, and hides. New York's Stock Exchange and Curb Exchange have four high-speed ticker systems.



NEW DIAL PHONE DEVICE SHOWS NUMBER CALLED

Getting a wrong telephone number, an annoyance both to the caller and the person responding, would be averted through the use of a device invented by a Portland, Ore., merchant. After being repeatedly called from a sick bed by careless users of dial telephones, he devised an attachment for this type of instrument to show the caller what number he is dialing.

Within the conventional circular ring of letters and numbers is a registering set of numerals resembling an auto mileage indicator. As each letter or figure is dialed, a duplicate of it appears in the center. Thus the user can see at a glance if he has dialed the wrong number. If so, he can hang up and avoid completing the call. The figures remain in view until another telephone number is dialed.

POWER CABLES IN OIL ARE SAFE FROM WATER

Running high-tension electric cables underground in oil-filled casings is the method recently adopted by an Ohio public utilities company to keep water out of their lines. Four 66,000-volt lines are buried in separate trenches three feet deep. Each line is divided in three cables which are twisted together something like the strands in a rope. Between the "strands" are placed oil channels. Since water and oil do not mix, the water is kept from the electric wires by the oil.

USE RADIO PILLOW IN PLACE OF HEADPHONES

When the listener's head rests on a new "radio pillow" he can hear music coming from a loudspeaker concealed within. A radio concern perfected this innovation so that hospital inmates might enjoy broadcast programs without disturbing other patients, and without wearing earphones. It may also be put into Pullman berths and chairs on ships.

This radio pillow takes the place of headphones.

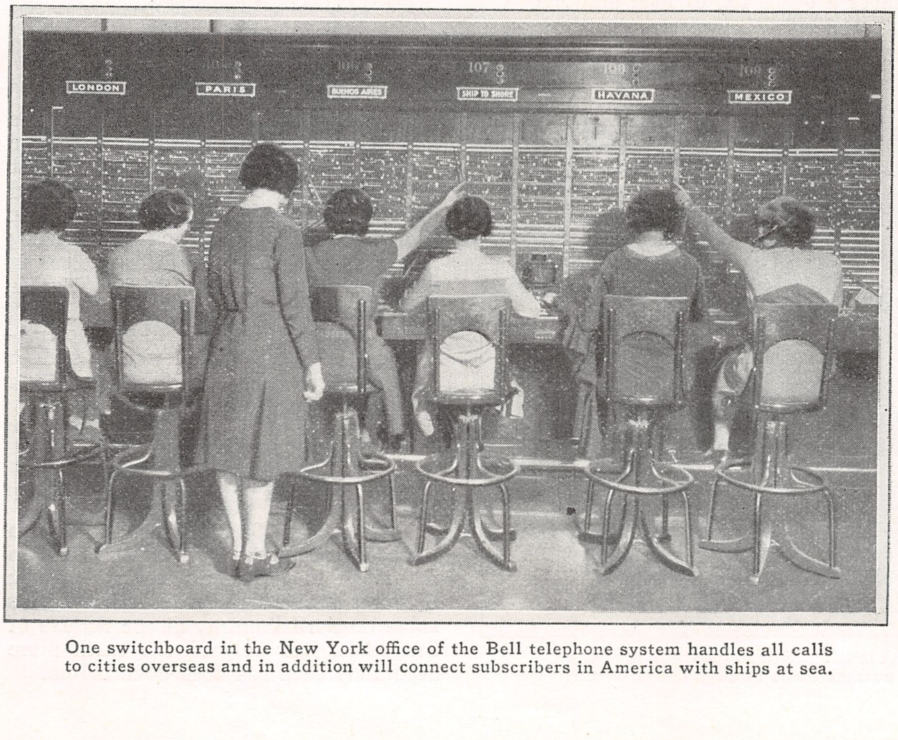
WORKSHOP MICROSCOPE REVEALS ALL DEFECTS

Especially designed for use in the machine shop is a commercial microscope recently placed upon the market. It aids inspection for defects of material or workmanship, magnifying them forty times. Fitted to its eyepiece is a scale graduated to thousandths of an inch, so that the size of imperfections may be measured.

WHEAT RUST BRED TO LEARN HOW TO END IT

At Washington, D. C., and at Winnipeg, Canada, exist the organisms of plant diseases that would wreak havoc if released in the wheat fields. The Washington species, a variety of "wheat rust," is so virulent that it will attack types of grain hitherto immune from parasites. Experts of the U. S. Department of Agriculture produced the virulent wheat rust by breeding for it. The object is to learn how to fight new hybrid diseases.

SWITCHBOARD HANDLES FOREIGN CALLS



One switchboard in the New York office of the Bell telephone system handles all calls to cities overseas and in addition will connect subscribers in America with ships at sea.

The average telephone switchboard may cover a town or part of a city, but a few girls at one New York City panel have most of the civilized world at their finger tips. This special switchboard of the Bell telephone system handles all its overseas calls. A placard above each operator's section shows what foreign point she is handling. Side by side sit girls who will plug in your call to London, Buenos Aires, Paris, Havana, or Mexico. At the center of the group shown in the photograph at the left, one operator connects subscribers in the United States with ships at sea equipped for radio telephone.

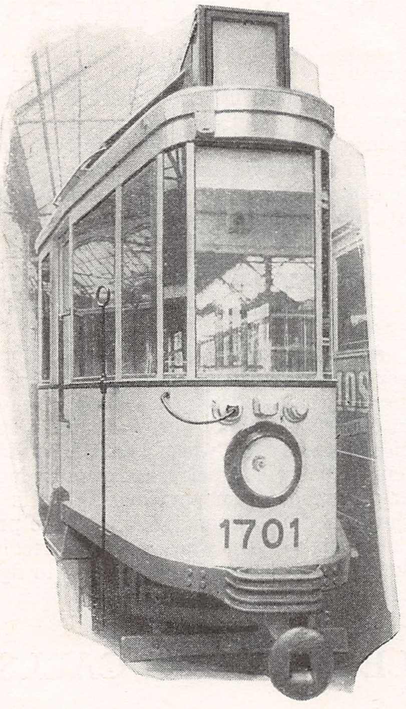
WORLD'S BIGGEST PLANT

Probably the largest plant in the world is a rare species known as the "box huckleberry." The trailing creepers of a single specimen of this amazing plant can cover one hundred acres with a thick mat. Yet the plant seldom reaches a height of more than six inches, according to the Field Museum of Natural History. It takes hundreds of years to reach its full growth

BUS ENGINES SPEED UP GERMAN STREET CAR

A NOVEL street car recently developed in Dresden, Germany, has a sharp narrow vestibule for the driver that not only gives an unobstructed view ahead, but permits the operator to see if motor cars are approaching from the side on turns. The car is driven at high speed by four motor-bus engines working through electric drive. It will get up speed, both ahead and in reverse, much faster than ordinary street cars of the trolley type.

Passenger comfort has been provided for by heavily-upholstered seats, deep windows, with a table at each one, and specially-designed springs to insure riding comfort. Designed for operation at a speed equalling that of a motor bus, these cars are equipped with efficient mechanical brakes with which they can be stopped as quickly and as easily as a bus to avoid accident when an emergency arises.



Four engines are used to drive this Dresden, Germany, street car at the speed of buses.

SLOT MACHINE SELLS PHONOGRAPH RECORDS

Now phonograph records are being sold by slot machines. An automatic vendor has recently appeared outside London theaters and shops that delivers a popular song hit upon the insertion of a coin. The records it sells are lightweight, flexible, and almost paper-thin, resembling an unbreakable record that recently appeared.

SECRET OF BELGIUM'S "POISON FOG" FOUND

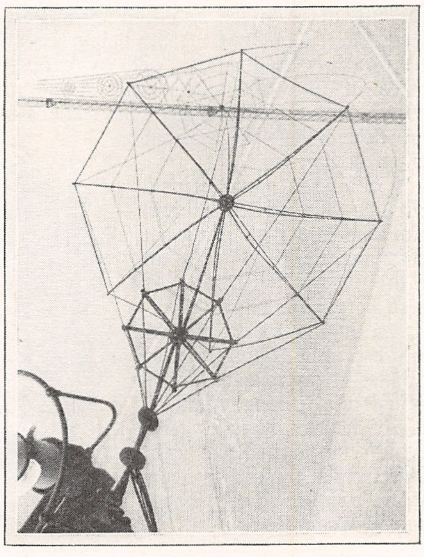
INVESTIGATORS have solved the mystery of Belgium's sensational "poison fog," which caused the death of more than sixty persons a few weeks ago. Sulphurous fumes, combined with the unusually thick fog to make an acid that attacked the lungs of the inhabitants. Presumably the noxious fumes came from the smokestacks of industrial plants in the Meuse Valley.

Any American industrial center generates similar fumes, but the possibility of a "poison fog" is remote because rarely do meteorological conditions in this country favor a dense fog of long duration.

BIG WIRELESS STATION HAS STRANGE ANTENNA

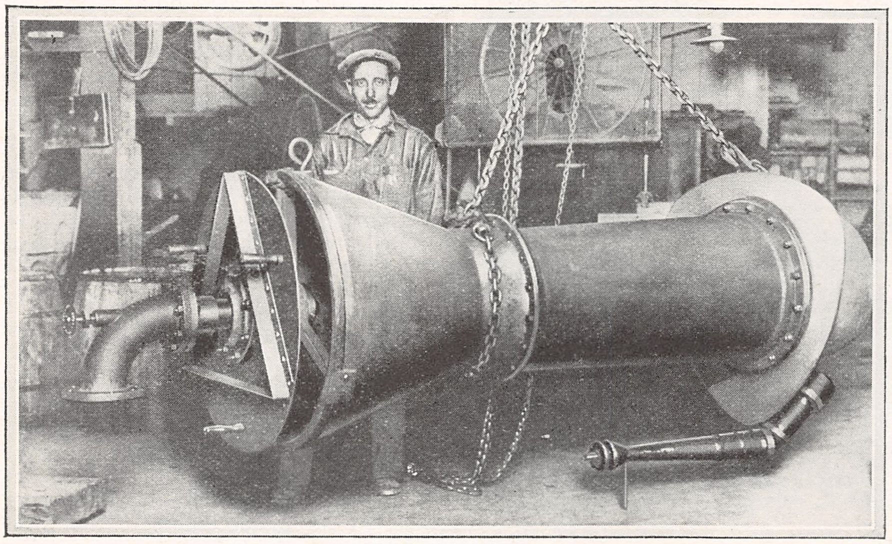
THE antenna arrangement at the world's most powerful wireless station, Rugby, England, resembles a huge spider web of steel and copper wires. From the odd-looking maze of wire atop the tall masts of the station, a network of radio communication extends to most parts of the world. Radio operators on ships on all seas are asked to stand by daily to receive the bulletin sent out regularly from Rugby's powerful instruments. It can send messages to all parts of the British Empire—India, Australia, Canada, and islands in the Pacific.

Rugby is equipped to transmit wireless telephone messages as well as those in telegraph codes. Four channels of communication between Rugby and the United States are now in operation and a fifth is being constructed. Separate aerial systems, for the purpose of communicating with nations to the west, south and east have been installed so that it is possible for this station to reach practically every part of the globe at the same instant.



This spider web affair is merely the strange antenna at the most powerful wireless station.

GIANT GAS JET HAS 15-INCH OPENING



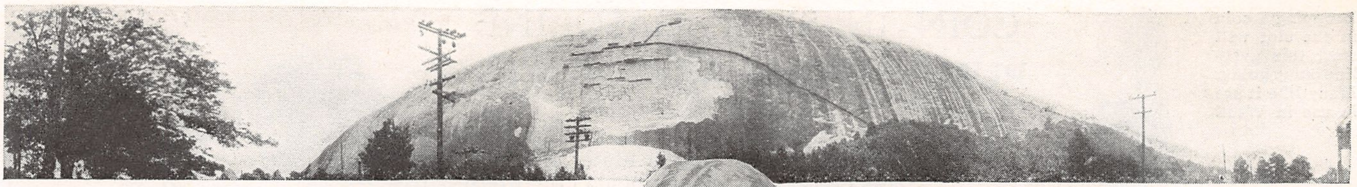
In four hours, this gas burner, fourteen feet long and fifteen inches in diameter at the opening, burns enough gas to heat average home through entire winter.

IMAGINE a gas burner that in four hours burns enough gas to heat the average home for a whole winter! Said to be the largest in the world, this one was recently installed in the Johnstown, Colo., plant of a sugar company. The burner is fourteen feet long and at the opening it is fifteen inches in diameter. It burns 50,000 to 60,000 cubic feet of natural gas an hour.

Installed in apparatus used for the manufacture of sugar, this device is said to have effected a saving of forty percent in firing as compared with coal.

CUTS WEIGHT OF EARTH

THE earth is 600 billion tons lighter, in the latest estimate of its weight. This does not mean that the equator is shrinking but simply that Dr. Paul R. Heyl, in his subterranean laboratory at the Bureau of Standards, has weighed the earth more accurately than has been done before.



BOX CAMERA CAN NOW TAKE PANORAMIC PHOTO

Anyone can make panoramic pictures with an ordinary inexpensive box camera, through a recent invention.

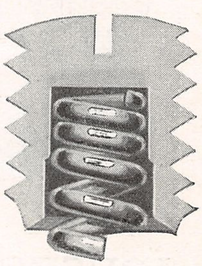
Hitherto special cameras have been required to make elongated "panoramic" pictures, covering a wide angle of view, and such machines have been beyond the purse of the average amateur. Not long ago Walter Davis, an Atlanta, Ga., disabled veteran who served as an aerial photographer during the World War, devised an attachment to enable a box camera to do the same job.

This attachment is a special head, in the form of a dial, interposed between the camera and the tripod on which it rests. To make a panoramic picture, the user snaps the shutter, then turns the camera horizontally until the dial indicates that the camera is in correct position for a second shot. The film is turned for a new picture, and exposed again. Any number of exposures can be made, until the camera has been turned in a complete circle if desired. The finished print shows no line or blurring where successive exposures join. Specially-marked film and a slotted disk to cover the lens are used.

Miss Frankie Davis, inventor's niece, with new camera.

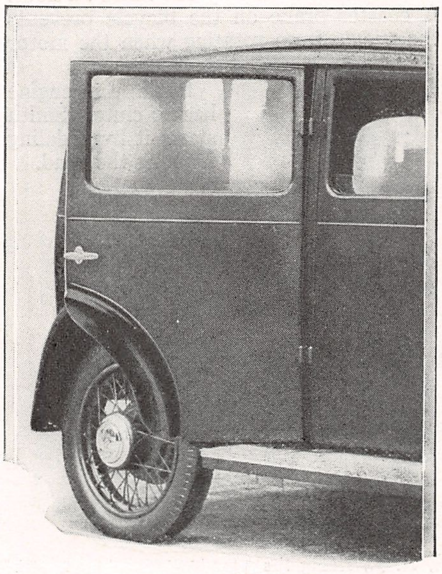
SPRING IN SET SCREW HOLDS DOOR KNOB FIRM

A self-locking screw for door knobs recently has been placed on the market in Boston, Mass. The small headless set screw that keeps knobs from working off the square spindles of locks is hollow, containing a little coil spring, shown in the accompanying illustration. One end of this presses against the spindle, the other against the inside of the screw, forcing it against the threads tapped into the knob and securely holding the screw. While the screw cannot come loose accidentally, it can be removed easily with a screw driver. This device is designed to eliminate one of the annoyances to which the average householder has been subjected. Rattling knobs, or one that comes off in the hand when an effort is made to open the door, are, according to its manufacturer, prevented.



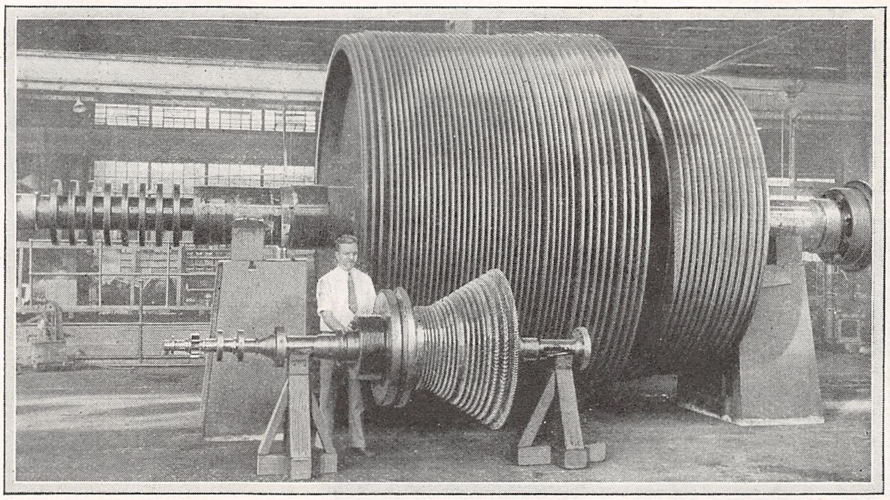
NEW ENGLISH CAR HAS MUDGUARD ON DOOR

Fixing a section of mudguard to the rear door is the idea hit upon by an English motor car manufacturer in getting the biggest body on the smallest chassis. Since the car was a light one designed for the use of families with small incomes, this method of economizing on body room and therefore on weight and gasoline consumption was necessary. The result was a five-passenger sedan on a chassis much smaller than would ordinarily have been used.



With the rear mudguard fastened to the door of this little car, a tiny chassis was possible.

THIS GIANT AND PYGMY GIVE SAME POWER



It is all a matter of speed, and the giant turbine spindle seen in the background turning slowly delivers exactly the same power as the little fast-turning rotor near it.

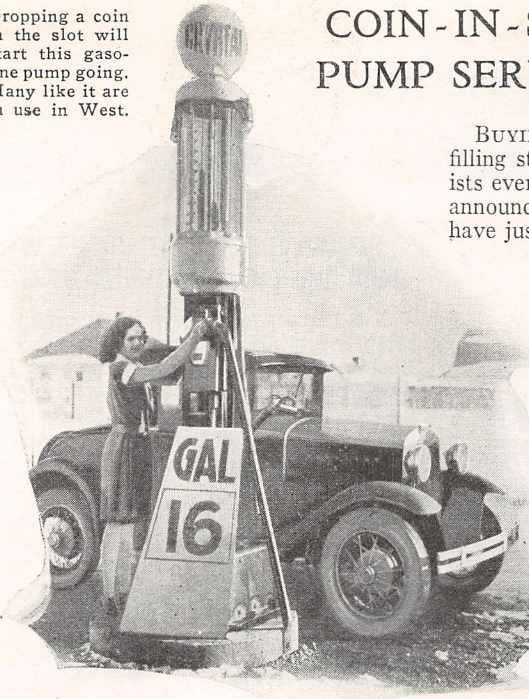
Different as they are in size, these two turbine spindles deliver approximately the same horsepower—7,000 each. The larger spindle in the background is for the United States battleship *Pennsylvania,* and works directly on the propeller shaft at 240 revolutions a minute.

The smaller rotor, seen with the man standing behind it, is for a higher speed vessel, such as a destroyer or yacht, and turns at 3,600 revolutions a minute, driving the propeller at lower speed through a reduction gear. The difference in speed causes the contrast in size between these turbine parts, which were photographed at the South Philadelphia, Pa., works of the Westinghouse company.

USES DISEASE GERMS TO MAKE A BATTERY

Making an electric battery out of disease germs was a recent feat of Dr. Barnett Cohen, of the Johns Hopkins Medical School. With wire he hooked together a set of glass vessels containing, alternately, cultures of growing germs and sterile solutions. A small but measurable electric current began to flow.

COIN-IN-SLOT GASOLINE PUMP SERVES MOTORISTS



Dropping a coin in the slot will start this gasoline pump going. Many like it are in use in West.

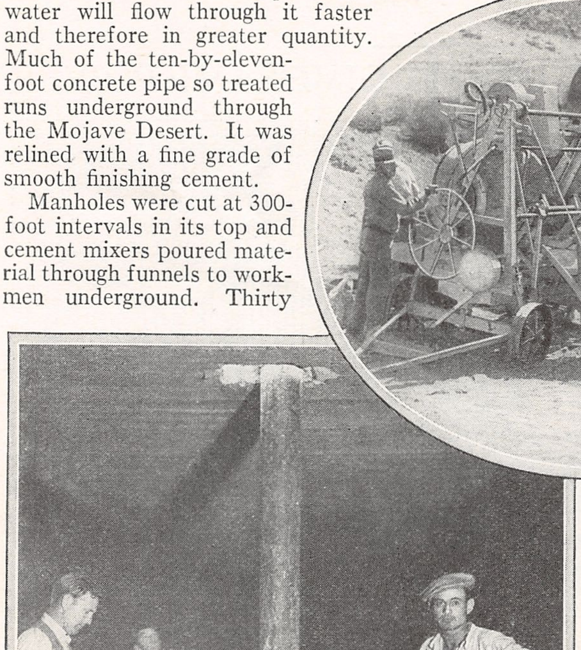
BUYING gasoline from a self-service filling station is brought nearer to motorists everywhere by a Colorado firm, which announces that its "robot" gasoline pumps have just completed successfully extensive tests in actual service.

When the motorist drops a coin in the slot—a quarter, half dollar, or a silver dollar—the robot automatically delivers to him the correct amount of gasoline. He can buy "gas" at any hour, is sure of accurate measurement, and need not wait for service or for change. From the service station owner's point of view, the robot saves the salary of an attendant and eliminates loss from his possible mistakes. Colorado stations that have installed the gas-selling robot report its operation as satisfactory.

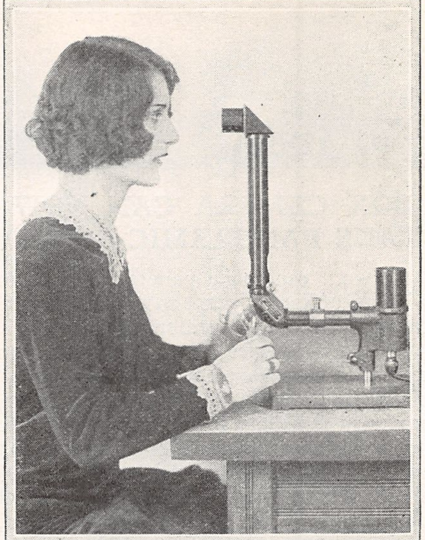
AQUEDUCT "SHINED" FOR MORE WATER

ENGINEERS of Los Angeles are just completing a 125-mile job of polishing. That city's water supply flows through a 250-mile aqueduct. As the city's growth increased the burden on the aqueduct, half of its interior was polished so the water will flow through it faster and therefore in greater quantity. Much of the ten-by-eleven-foot concrete pipe so treated runs underground through the Mojave Desert. It was relined with a fine grade of smooth finishing cement.

Manholes were cut at 300-foot intervals in its top and cement mixers poured material through funnels to workmen underground. Thirty miles of inside surfacing was done in a ten-day period. It is estimated that refinishing the pipe line will furnish an additional 28,000,000 gallons of water.



Inside the Los Angeles aqueduct which is being lined with smooth cement. In circle, the cement mixer busy in desert.



GAGE GIVES THICKNESS OF GLASS IN BOTTLE

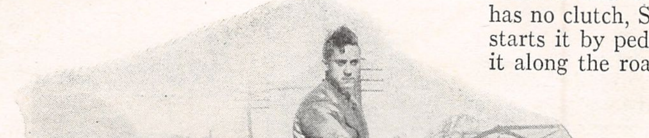
A NEW instrument, called the "optical thickness gage," which looks like a periscope, measures the wall thickness of sealed flasks and bulbs. In many instances this knowledge is of great importance. Glass tubes must often withstand either high pressure or high vacuum within certain margins for the safety of the user and for economy of production.

The "optical thickness gage" is so simple to use that girls with no knowledge of physics or the laws of reflection and refraction operate it. The electric bulb is held before an opening in the instrument as shown in the picture and the thickness of the glass wall is read on a scale in the eyepiece, in which the girl is looking.

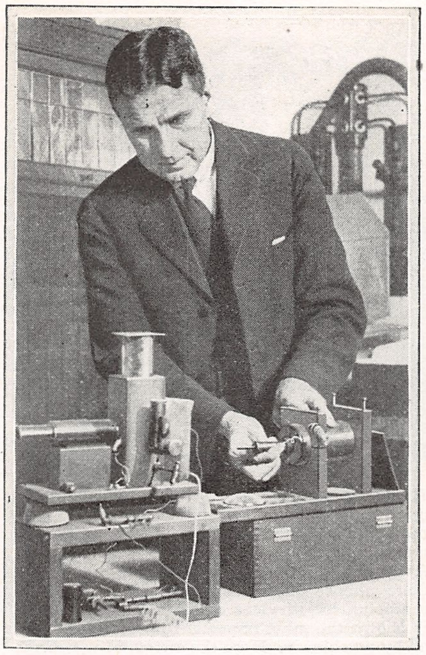
WASHING MACHINE MOTOR USED TO RUN BICYCLE

DONALD SMITH, of Flemington, N. J., recently constructed an ingenious motor "pusher" for his bicycle from a washing machine motor. It consists of two bicycle wheels driven by a three-quarter-horsepower one-cylinder gasoline engine. Attached to the rear, it pushes it along at from sixteen to twenty-one miles an hour. A coaster brake on the bicycle prevents the pedals from rotating when the motor is in use.

Since the engine has no clutch, Smith starts it by pedaling it along the road.



Donald Smith, Flemington, N. J., riding his bicycle powered with washing machine motor.



PUTS EARTH'S AGE AT 1,852,000,000 YEARS

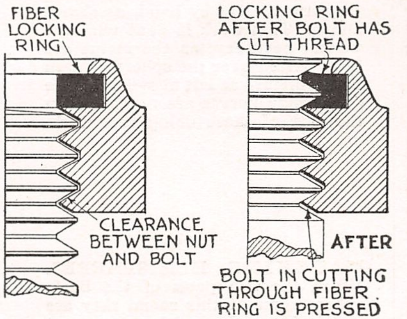
How old is the earth? It celebrates its 1,852,000,000th birthday this year, according to a new estimate made by Dr. Alois F. Kovarik, of Yale University. He reckons its age from the "decay," or amount of change, of elements in the rocks.

The earth, when born, contained all the elements we know today, including uranium. Ever since the earth's birth, a portion of its uranium has been turning into radium, which in turn has been slowly changing into lead.

The rate of this change, or "decay," is known, and is believed to be unalterable. By measuring how far the decay has progressed in "uranite," a mineral from Russia, Dr. Kovarik arrived at his figure.

NUT WITH ELASTIC RING CAN'T WORK LOOSE

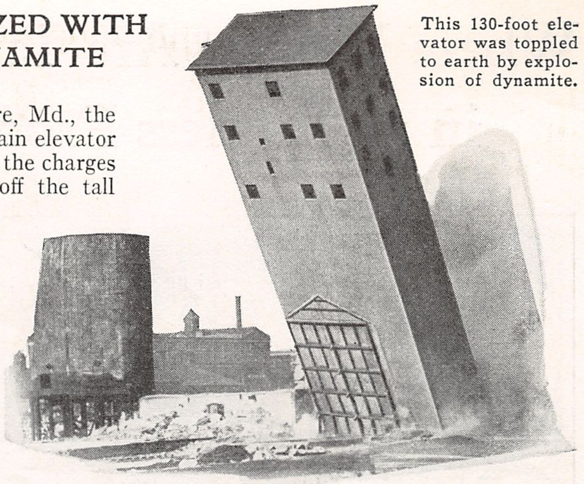
A NEW nut for use on all kinds of machinery from automobiles to airplanes and turbines cannot work loose. The threads of bolts on which it is used cut their way through an elastic fiber ring at its top. This draws the nut up until its metal threads press against the sides of threads on the bolt, making it impossible for them to work loose through vibration.


FIBER LOCKING RING
LOCKING RING AFTER BOLT HAS CUT THREAD
CLEARANCE BETWEEN NUT AND BOLT
AFTER
BOLT IN CUTTING THROUGH FIBER RING IS PRESSED DOWN AGAINST NUT TAKES UP CLEARANCE AND LOCKS THEM TOGETHER
BEFORE

This diagram makes clear how a nut is held so that vibration will not jar it loose. Note that fiber ring presses nut and bolt together so clearance is closed.

TALL BUILDING RAZED WITH CHARGES OF DYNAMITE

HOUSE wreckers in Baltimore, Md., the other day pushed a 130-foot grain elevator over by dynamite. They placed the charges so that when they were set off the tall structure fell upon the exact location they had previously selected. So sound was the concrete building that its walls did not crack from the explosions but it fell in one piece; then was shattered as it struck the ground. Many panes of glass remained intact as it toppled. This method of wrecking the building saved much time, for the concrete was broken into fragments that were comparatively easy to handle. At right the building is seen still intact as it fell.



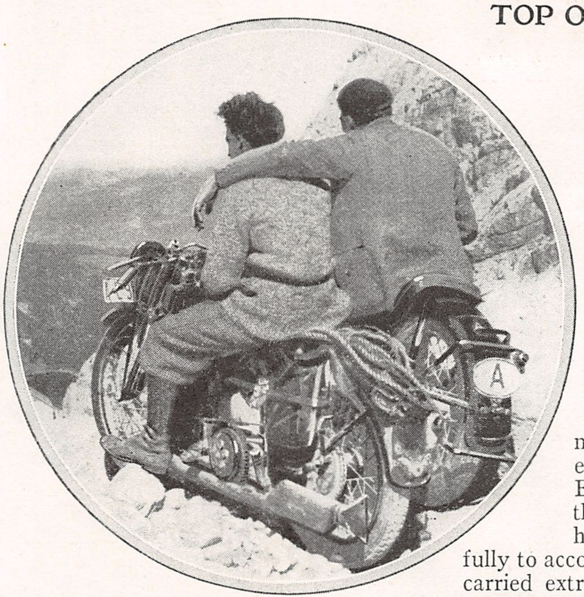
This 130-foot elevator was toppled to earth by explosion of dynamite.

So skillfully were the charges of dynamite placed under this building that it fell upon spot selected.

RIDE MOTORCYCLES TO TOP OF AUSTRIAN ALPS

Two young Austrians, Herbert Sartorius and Toni Pospischil, recently established what they believe to be a world's altitude record for motorcycles. They drove their machines to the top of a high peak in the Austrian Alps in the course of a trip from Carinthia to Tyrol, two provinces of Austria.

Most of their route lay over mountain passes, snow fields, and rough mountain roads. Disaster nearly overtook the daring riders many times on their trip. Exceptional driving skill and the reliability of their machines, however, enabled them successfully to accomplish the difficult feat. They carried extra fuel and a complete repair outfit with them so that in the wildest sections they were far from helpless.

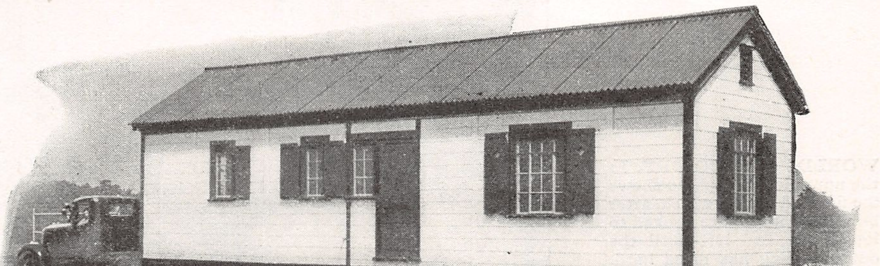


These two Austrians set a record when they rode motorcycles to the top of Alpine peaks.

COMPLETE NEW HOUSE COMES BY TRUCK

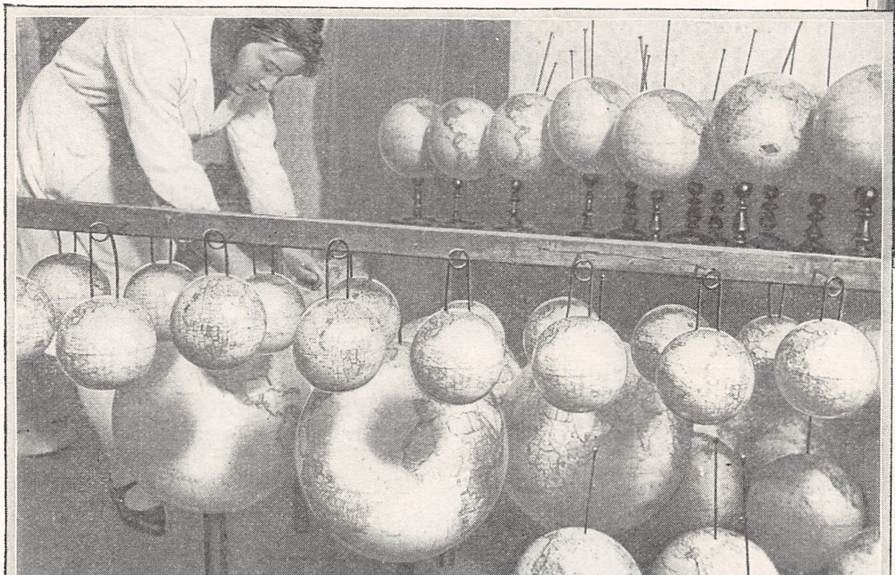
DELIVERING a complete house to your property by motor truck is the plan of a Farmingdale, N. Y., firm. Small steel frame dwellings are put together at its plant and equipped with range, water heater, electric fixtures, and bathroom fittings.

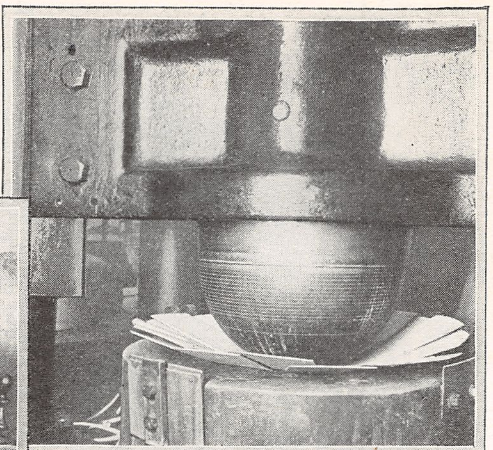
These are not sectional houses, but structures permanently put together and all ready to live in. They are supplied in sizes ranging from three to five rooms, with or without a garage. This system of steel framing is said to have speeded up construction and proved as satisfactory in small dwellings as in skyscrapers.



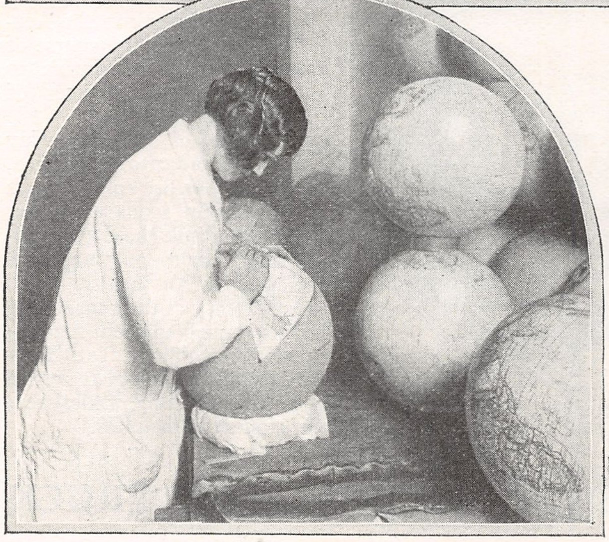
It is now possible to order a house by phone and get it sent to you by truck.

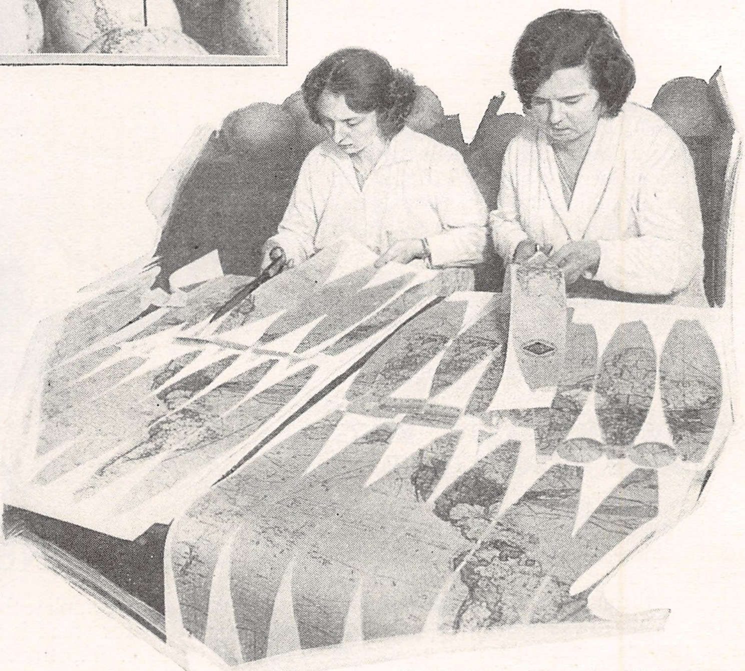
Where Worlds Are Turned Out in an Endless Procession





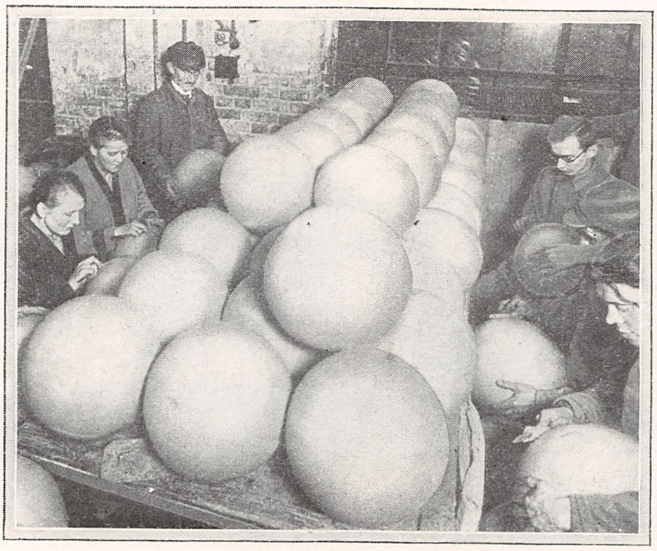
HOW WORLDS ARE MADE. On this page are pictured the many and interesting steps in the process of making globes in a famous German factory. This, you will note, is one of the few remaining big industries where the work is done almost exclusively by hand, each step requiring the services of skilled labor. Above is shown the most important operation carried on by machinery. Here the strips, of which the basic spheres for globes are made, are being forced together by a powerful hydraulic press.





PUTTING ON THE MAPS. When the finished sphere which is the base of the globe comes to this room the strips that make up the map of the world are pasted on with the greatest care. This is a difficult task entrusted only to the skilled workers, as the edges of the strips must match perfectly.

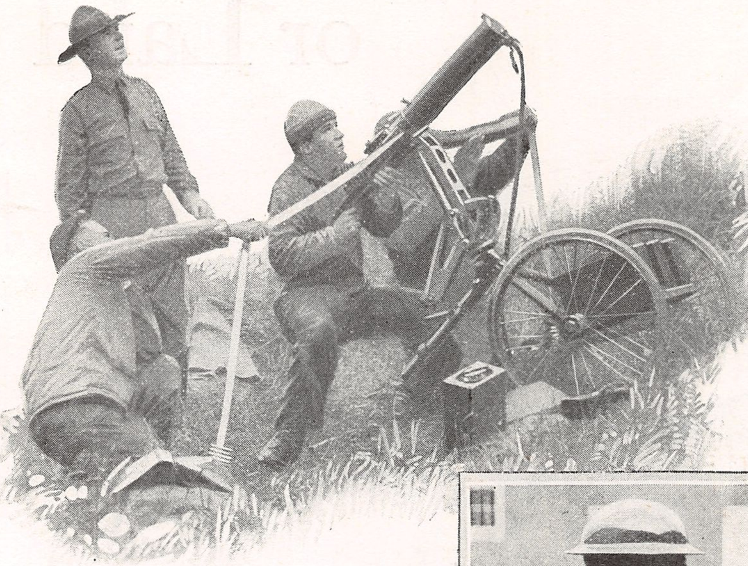
SECTIONS OF THE WORLD. Maps of the world are printed on great sheets of paper from which they are cut out by hand, as shown above. This work is done with the utmost accuracy, as the strips are later pasted over the sphere as seen in the picture at left above. Practice and steady nerves are necessary on the part of those doing this work.



WORLDS OUT TO DRY. In the upper left, the photo shows the finished globes which, after being varnished, are hooked to long poles and left until the outer coating has dried hard. Note that the worlds are of various sizes from the little fellow designed for the use of children to the big ones fit to grace a corner in the library of an accomplished geographer. When dry the globes are ready to be packed and shipped away.

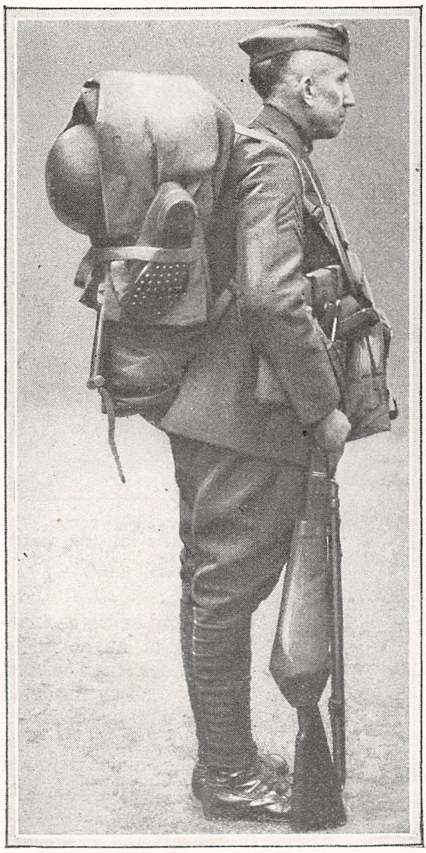
MATCHING HEMISPHERES. When the two parts of the basic sphere come to this room, they are matched together with the utmost precision and sealed solidly in place. This operation, with both men and women engaged at it, is shown in the picture at the left. The next step is the pasting on of the map strips. Few of the steps in the making of a globe are done by machinery because there is no demand for mass production, the market being limited.

Soldier's Life Made Easier

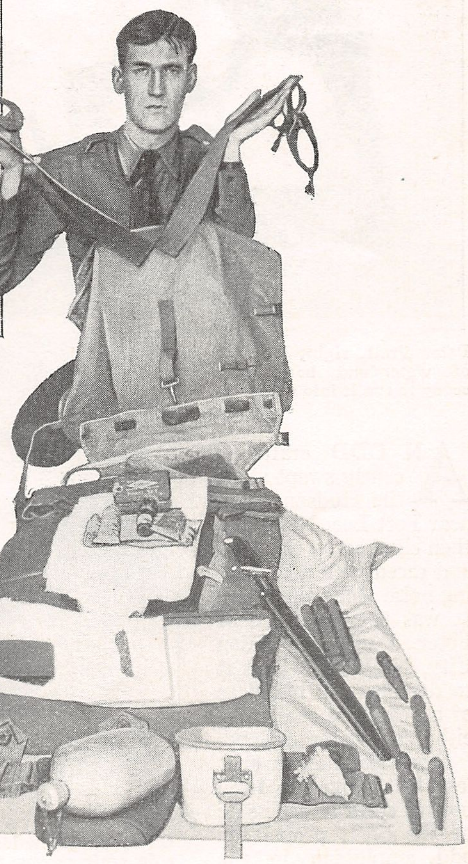


MACHINE GUN ON WHEELS. Formerly a machine gunner loaded his weapon on his back and carried it into battle. This heavy and exhausting work is no longer necessary, as the gun is now mounted on a rubber tired, ball-bearing cart which is easily dragged along into action. This is only one of many things that have been done to make the life of a soldier in today's Army less arduous.

DESIGNED TO MAKE SOLDIER HAPPY. Above and at left are two views of the pack now carried by foot soldiers in the American Army. It weighs 62¾ pounds, but it is carried with minimum fatigue even on long hikes because every item from pack harness to gas mask has been designed with the private's comfort and fighting efficiency in view. This is the regulation field pack now in use during all training maneuvers.

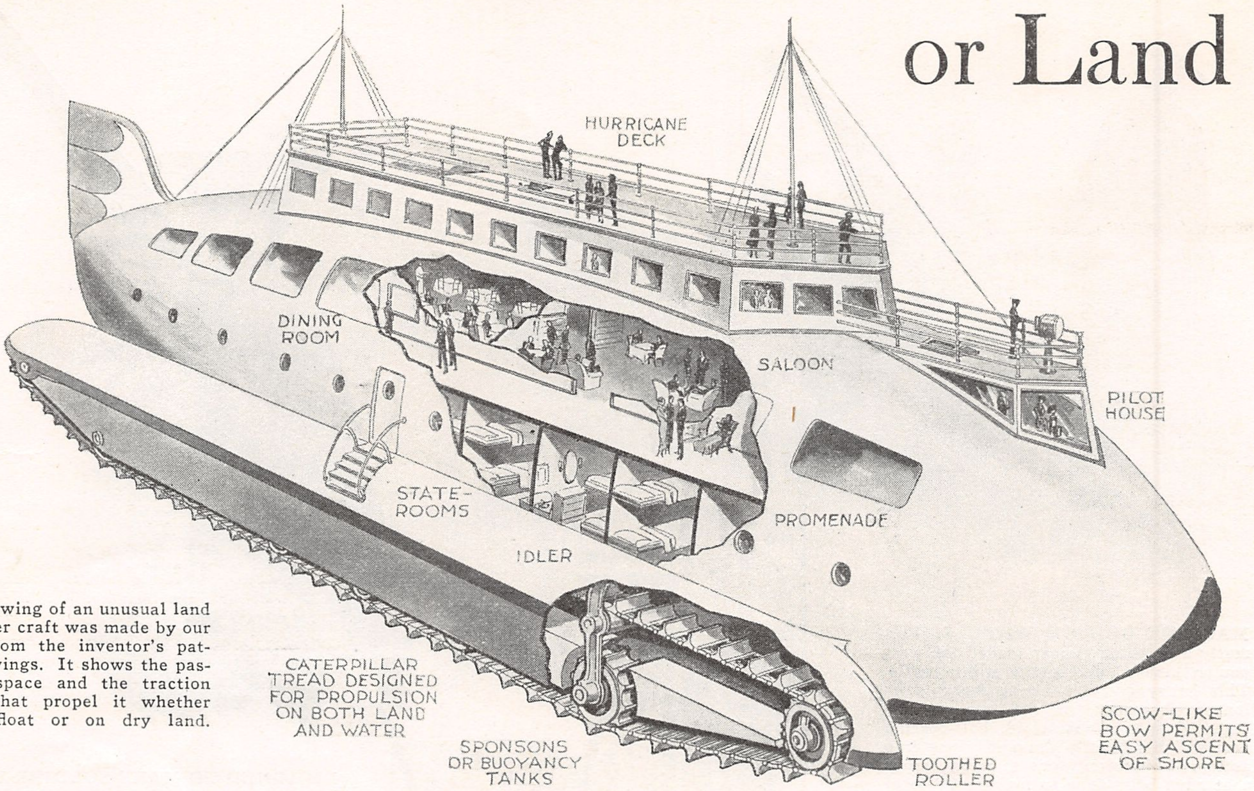


LOADED FOR WORLD WAR. Loaded down with a burden like this, the soldier of 1918 was sent into the front trenches. Not only was it heavy, weighing as much as all the equipment the soldier has today, but it was awkward to carry because it was not designed to promote comfort.

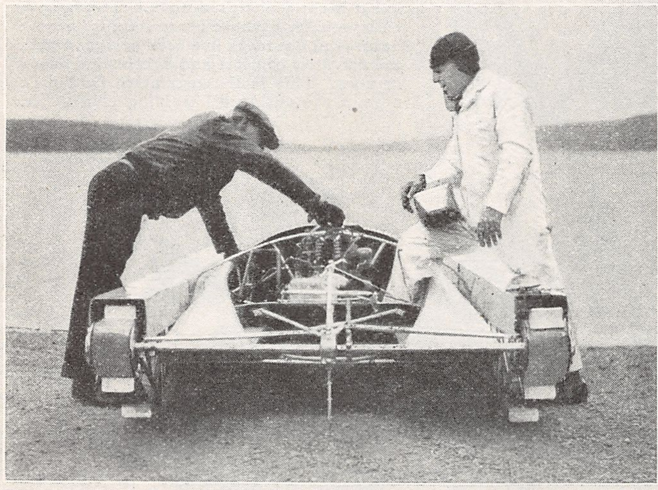


JUST LIKE HOME. Everything the foot soldier uses when he goes into a wartime camp must be carried on his back. At right is the pack now in use, opened for inspection. In it are all necessaries from private's tent to his safety razor.

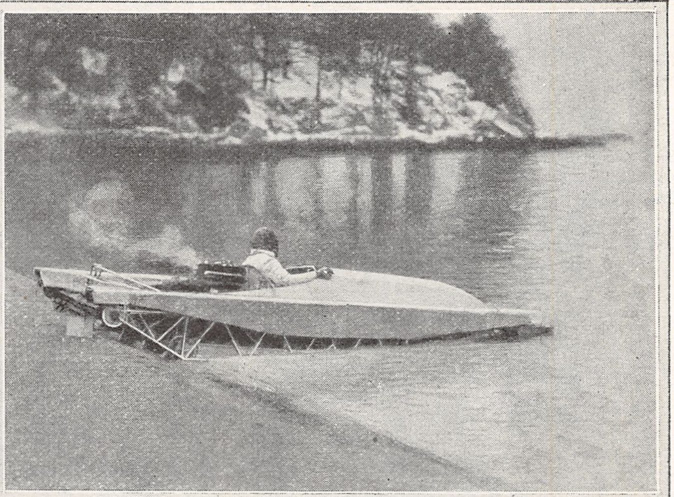
Strange Craft at Home on Water or Land


HURRICANE DECK
DINING ROOM
SALOON
PILOT HOUSE
STATE-ROOMS
PROMENADE
IDLER
CATERPILLAR TREAD DESIGNED FOR PROPULSION ON BOTH LAND AND WATER
SPONSONS OR BUOYANCY TANKS
TOOTHED ROLLER
SCOW-LIKE BOW PERMITS EASY ASCENT OF SHORE

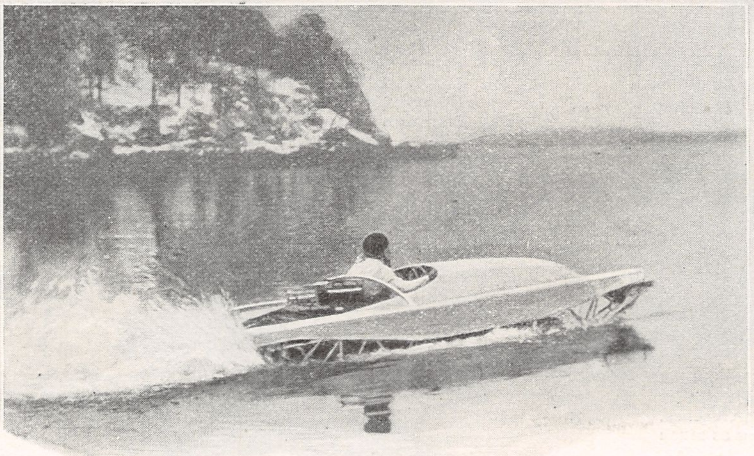
This drawing of an unusual land and water craft was made by our artist from the inventor's patent drawings. It shows the passenger space and the traction drives that propel it whether it is afloat or on dry land.



Peter Prell, right, inventor of water-land boat, gets ready to run it into the river.



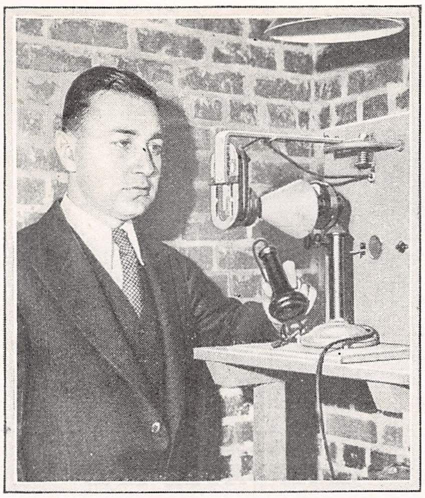
Like some big turtle, the craft crawls into the water.



On each side the long line of shallow paddles send the water flying as Prell's remarkable craft proves its ability to travel at a fast clip during a serious water test.

AN ODD craft recently swept along the Hudson River near Fort Lee, N. J., and then climbed up the bank and raced with a crunching noise along the shore. It was the invention of Peter Prell, of Union City, N. J., who built it to demonstrate his ideas of a boat that can travel either on water or land.

Small paddles on endless belts, running from bow to stern at each side of the boat, propel the odd amphibian in the water, and serve as tractor lugs to enable it to crawl over land. Prell has designed and applied for patents on a larger craft, built on the same principle and powered by Diesel-electric machinery. Such vehicles, he declares, might carry a hundred passengers. They would be particularly well adapted for river navigation, and on a winding river could save time by crawling across the spits of land that form the bends.



MACHINE KEEPS TAB ON WATER SUPPLY

An iron watchman who never sleeps keeps track of the depth of water in Washington, D. C., reservoirs. Whenever engineers want to know the level of water they call up this automatic electric indicator, pictured above. A series of buzzes in the receiver constitutes its reply to their question. The buzzes are arranged in code form, indicating the depth of water in the reservoirs.

FREAK OIL WELL SPOUTS IN STREET

Strangest of oil wells is the one that burst forth from the middle of an Oklahoma City, Okla., street the other day. Since it gushed without warning, workmen had no time to arrive at the scene with means for controlling it. For days it raged unchecked, only a block from the business district and in an area surrounded by residences.

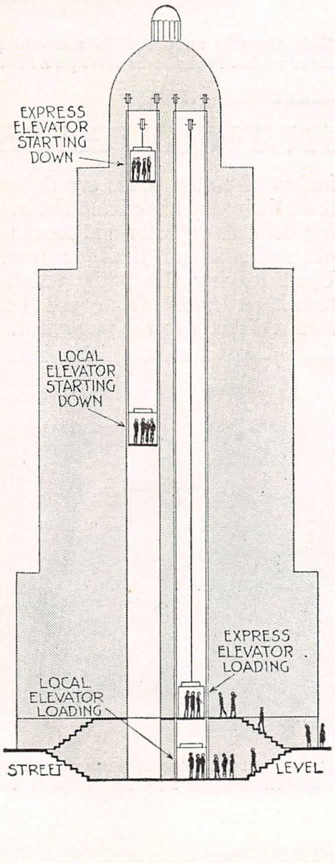
The uncontrolled geyser of oil, gushing from the ground and filling all gutters for blocks around, constituted a serious fire hazard. Troops of the National Guard patrolled the streets day and night to keep residents of the section from lighting fires in their homes. The scratching of even one match in that neighborhood might have started an appalling fire by igniting the gas and oil held in suspension in the air. Before it was gotten under control the gusher presented a strange spectacle, because it is extremely unusual to see one without the drilling derrick.

Without warning, this oil well spouted in the middle of a street in Oklahoma City, endangering many lives.

TWO ELEVATORS RUN IN ONE SHAFT

Last month Popular Science Monthly described the amazing proposal of a New York electrical engineer, Frank J. Sprague, to run "express" and "local" elevators in the same shaft. Now engineers of the Westinghouse Electric and Manufacturing company, with whom he acted as consultant, announce that they have perfected such a system. What is more, they have actually completed the world's first installation of two elevators in one shaft.

Upper floors are reached by taking the top, or "express" elevator. Beneath it in the same shaft, a "local" elevator serves the lower floors. Block signals like those of a railroad keep the cars at a safe distance from each other. Each operator in the car watches an illuminated panel that flashes a green light when the headway is clear, amber for caution, and red when the other car is approached. Automatic safety stops make a collision impossible.

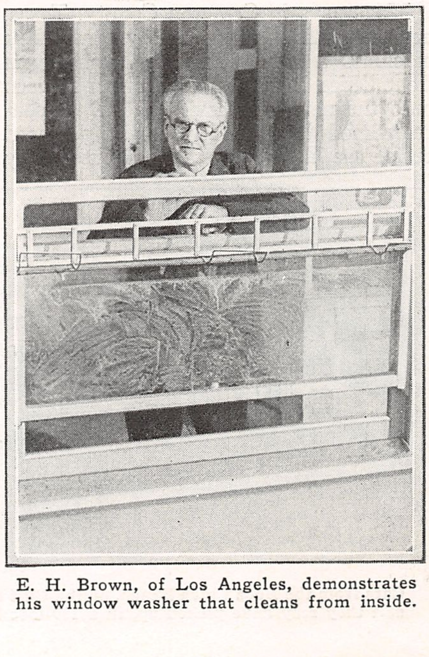


Above, the express elevator in the two-car shaft loaded and ready to start. At right, diagram indicating manner in which the two elevators are operated.

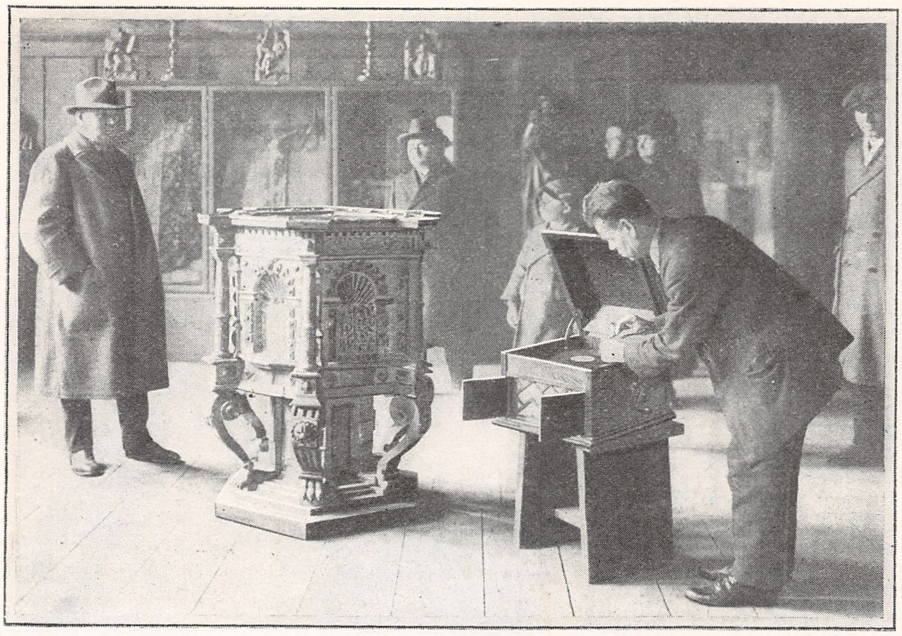
OUTSIDE OF WINDOWS CLEANED FROM INSIDE

Window cleaners may no longer have to hook themselves on window sills at dizzy heights above the sidewalks as they ply their trade on tall office buildings. E. H. Brown, of Los Angeles, Calif., has invented an apparatus that cleans windows from the outside while the cleaner remains within. Besides being safer, the washer does a more thorough job.

A framework, fitting into slots on both sides of the window frame, carries scrubbers and driers that press against the panes. Raising or lowering the sash cleans and dries the pane at one operation. The framework is light and easily portable, so that it can be carried about a building from window to window.



E. H. Brown, of Los Angeles, demonstrates his window washer that cleans from inside.



PHONOGRAPH REPLACES GUIDES IN MUSEUM

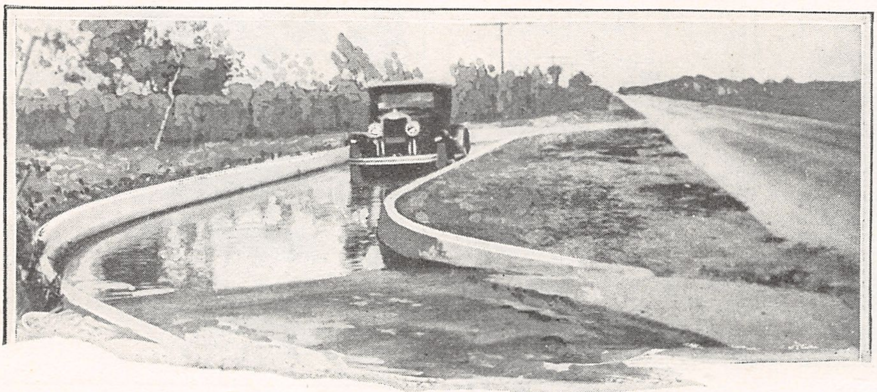
VISITORS to a Berlin, Germany, museum hear the exhibits and displays of unusual interest described by a phonograph, which does away with guides and personally-conducted parties. Thus patrons of the museum no longer have to wait until guides make up parties, but may wander at will through the exhibition rooms.

EDISON PLANS ROCKET TO AID PLANES IN FOG

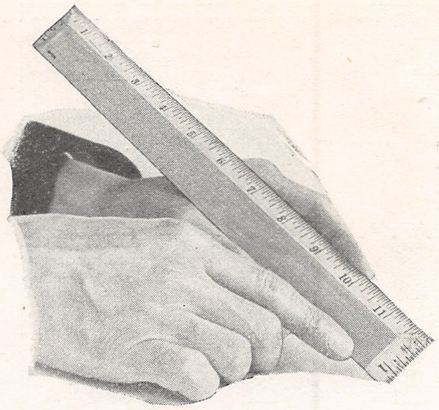
THOMAS A. EDISON recently told Lieut. Richard Aldworth, director of the Newark, N. J., airport, that he had been experimenting with an exploding rocket to help incoming aviators get their altitude in fog. Such a rocket would be timed to explode at a fixed altitude of 4,000 feet. It would attract the attention of the airman by its noise, smoke, and light.

CARS FROM BEACH RUN THROUGH BATH

MOTORISTS in Cameron County, Texas, near the Rio Grande Valley, give their machines a bath when they come from Boca Chica Beach on the Gulf of Mexico onto the new Brownsville Road. A concrete-lined trough 150 feet long placed beside the highway contains about twenty inches of water. Cars are driven through it on their way back from the beach, washing off salt deposits and sand that might otherwise injure tires or running gear. Upon leaving the bath, which is about seventeen miles from the beach, cars return directly to the pavement.



Cars from the Boca Chica Beach, on the Gulf of Mexico, get a chance to wash off the sand and salt they may have picked up, in a 150-foot bath built along the new Brownsville turnpike.



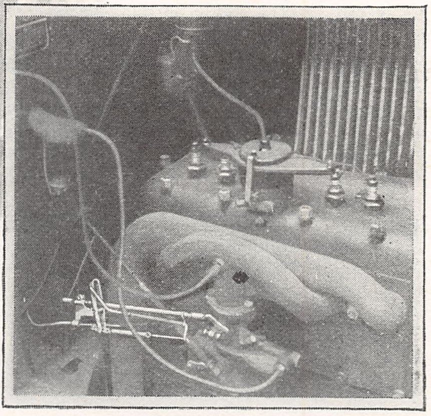
MECHANICS' RULE HAS GRADUATED END

A RULE developed by a Seneca Falls, N. Y., manufacturer, has graduations on ends and edge. Where there is not sufficient room for the rule to be used lengthwise, its short side, graduated in fractions of an inch, gets any measurement up to one and one quarter inches.

HUMMING WIRES WARN OF STORM

WIRES strung at right angles to each other were tested recently by electrical apparatus to see if their hum changed with the approach of a storm. It was found that it did, even though atmospheric disturbance was at a distance.

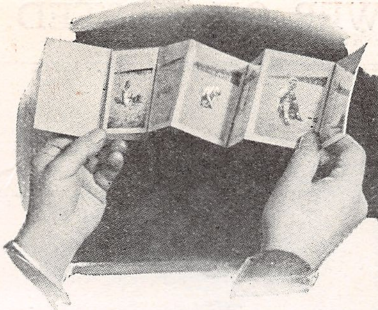
This throttle on the car's gear-shift lever makes it easier to start on a hill.



GEAR-SHIFT THROTTLE HELPS AUTO DRIVERS

A MOTOR car throttle operated from the gear-shift lever knob is a new product of a Mansfield, Ohio, firm. Shifting gears and operating the throttle with one hand at the same time leaves both feet free for clutch and brake. This makes starting on hills and driving in heavy traffic easier. The device can be quickly applied to a popular make of small car without machine work such as boring or drilling holes.

Many new drivers have difficulty in learning how to operate the brake and throttle so that no trouble is experienced in starting a car that has been forced to stop on a steep hill. Minor accidents due to the car rolling backwards into cars behind not infrequently occur in this situation. The gear-shift throttle is designed to remedy this difficulty.



FOLDING POCKET CASE PRESERVES PICTURES

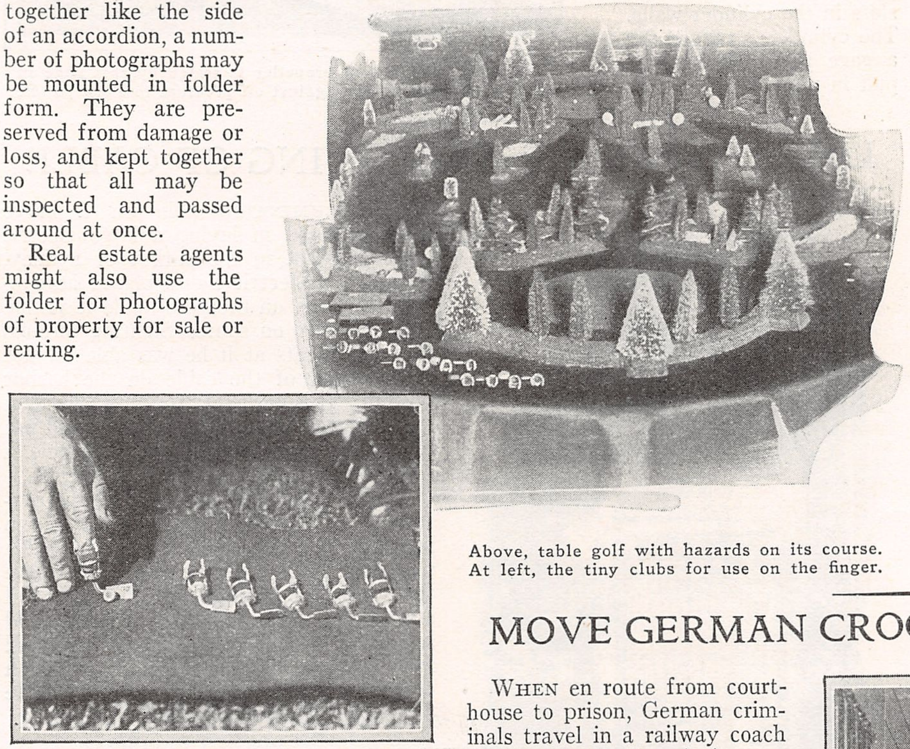
PROUD fathers who like to show around the pictures of their babies, and travelers returning with prized photographs of a vacation trip, are prospective users of a handy little pocket case for pictures that has recently appeared on the market. On its hinged leaves of cloth board, which fold together like the side of an accordion, a number of photographs may be mounted in folder form. They are preserved from damage or loss, and kept together so that all may be inspected and passed around at once.

Real estate agents might also use the folder for photographs of property for sale or renting.

USE MIKE TO MEASURE NOISE IN SUBWAY

NEW YORK subway riders were surprised recently when several young men walked into a car, set up black boxes, and began to jot down figures in notebooks as the train proceeded. The observers of an electrical laboratory were measuring noise made by a subway train. With the aid of their report, the company operating the subway will attempt to remove some of the din from the life of underground travelers.

Picking up noises in the car was a cylindrical microphone like those of radio broadcasting stations, hung from one of the metal "straps" and visible in the photograph behind the hat of the observer with a notebook. Its electrical impulses were conducted through an amplifying box and registered upon numbered dials so that the intensity of noise from moment to moment could be measured and recorded for future reference.



Above, table golf with hazards on its course. At left, the tiny clubs for use on the finger.

TABLE GOLF WITH TINY CLUBS IS NOW HERE

BEYOND a doubt the tiniest thing in miniature golf is a new game for the dining room table, recently introduced in Denver, Colo. "Clubs" are thimblelike devices to be slipped upon the index finger. They are made in a variety of shapes in imitation of the driver, brassie, mashie, and other clubs of the standard game.

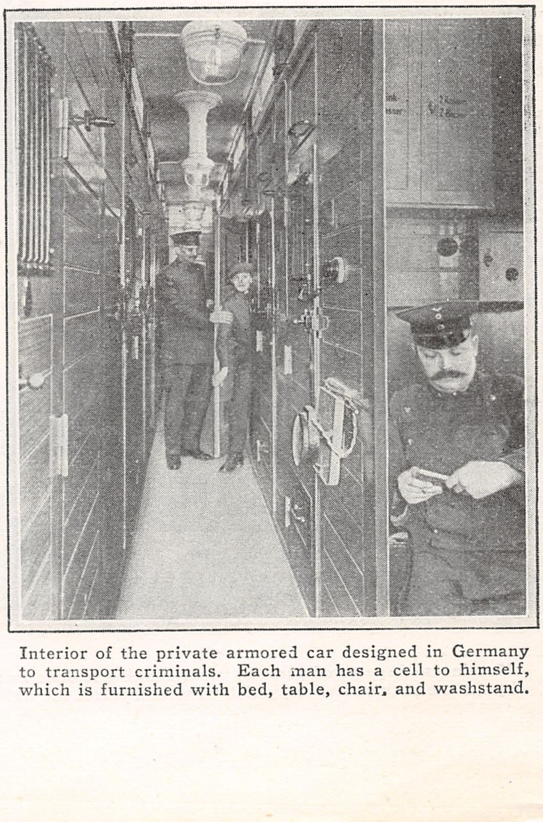
With these tiny implements, the player propels a ball about the size of a small marble, and as hard as a conventional golf ball. The "course" is made of felt, on which greens, trees, lake basins, and sand traps are arranged in a skillful effort to give the table course the familiar appearance of full sized links. The weight and balance of the clubs in relation to the ball are of as great importance in this new game as in outdoor golf.

Beginners can learn much about regular golf from this game, according to its inventor, Daniel G. Lilley, of Denver.

MOVE GERMAN CROOKS IN PRIVATE CAR

WHEN en route from courthouse to prison, German criminals travel in a railway coach designed for their exclusive use. It is heavily armored and guarded, so there is little chance for a prisoner's friends to effect his release while the car is on the road. Separate "cells" are provided for each prisoner, containing a bed, table, chair, and washstand.

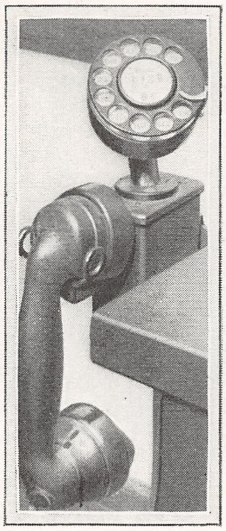
The car really constitutes a moving block of cells in many particulars exactly like those found in modern prisons. Not only is the safety of the prisoner insured by this car, but it has the humane feature of providing the offender with transportation without subjecting him to the curious gaze of fellow travelers. One objection, of course, lies in the fact that it would be expensive to use the car for only one or two prisoners. It is useful, however, in transferring men from one prison to another.



Interior of the private armored car designed in Germany to transport criminals. Each man has a cell to himself, which is furnished with bed, table, chair, and washstand.

NEW OFFICE TELEPHONE HANGS AT DESK'S SIDE

TELEPHONE wires and cords are banished from the desk by a new type phone now obtainable. Thus the top of the desk is kept clear as a working space. The instrument hangs at the side of the desk, where it easily can be reached from the chair and the dial face is toward the user so that numbers and letters are clearly discernible. One hand holds mouthpiece and receiver, leaving one for writing.

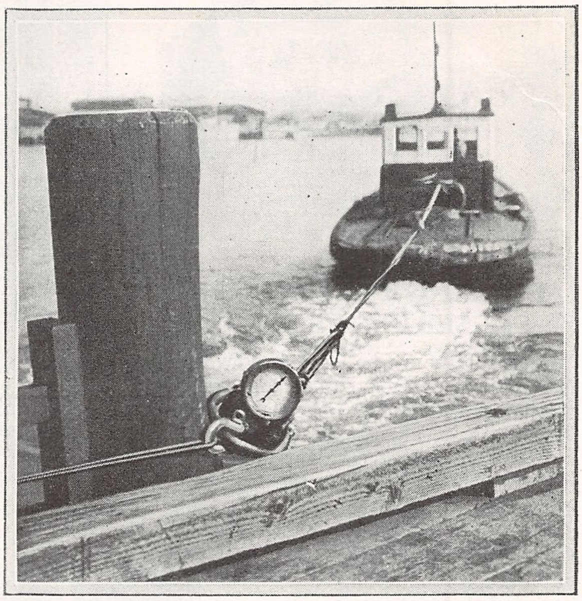


Working space on top of office desk is kept free of cords by use of this new type telephone.

BOAT PROPELLER'S POWER OIL-TESTED

WHILE all propellers of the same size having the same number of blades may look as much alike as peas in a pod, nevertheless there is a vast difference in their performance. A simple means of selecting the type of propeller that will deliver the greatest power has been devised by an Alameda, Calif., towboat company.

The device consists of a ten-inch wrought steel cylinder with a six-inch bore, in which a piston works against heavy oil when the strain is applied. A bridle is connected to the piston on opposite sides through slots in the cylinder walls. The cylinder is tapped for a gage that registers the pull in pounds.



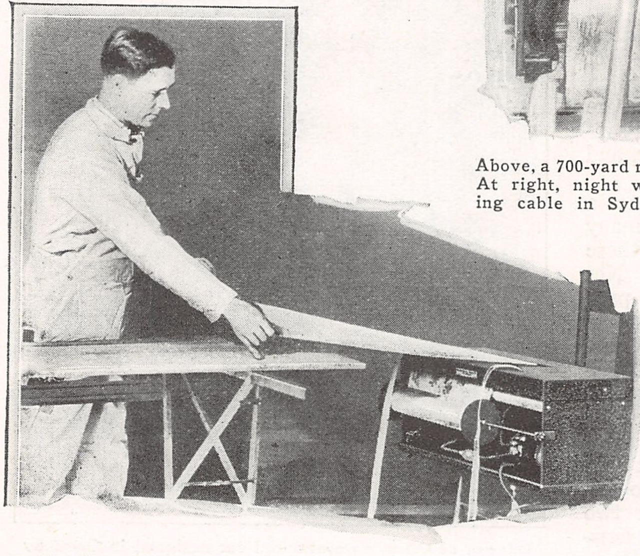
The efficiency of a boat propeller is tested by this gage in which a piston is driven against oil pressure to show power.

AMERICAN WIVES OUTLIVE THEIR HUSBANDS

THE average American woman has six chances out of ten of being left a widow, while her husband has but four chances out of ten of being a widower. That is the conclusion of officials of insurance companies whose duty it is to reduce the chances of life to figures. It is explained by the tendency of American men to marry late in life, and choose wives younger than themselves.

MACHINE PASTES AND TRIMS WALL PAPER

A NEW electrically-driven machine recently perfected in St. Louis, Mo., shortens the paper hanger's visit. Any standard-sized roll of wall paper placed in this machine passes through rollers which automatically cover it with paste, trim the edges, and deliver it ready to be placed on the wall without waste of time.

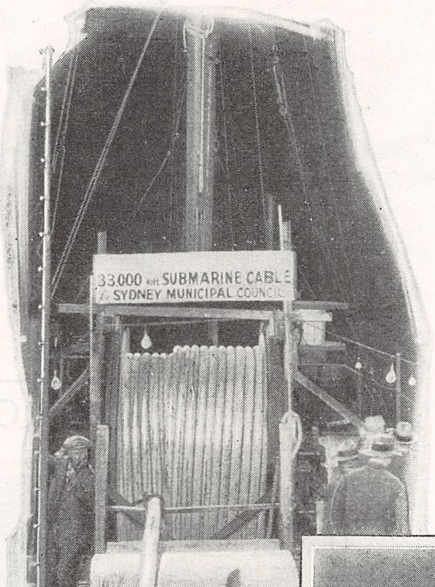


Mussiness of spattered paste in paper hanging is done away with by the use of this machine, which trims and pastes the wall paper.

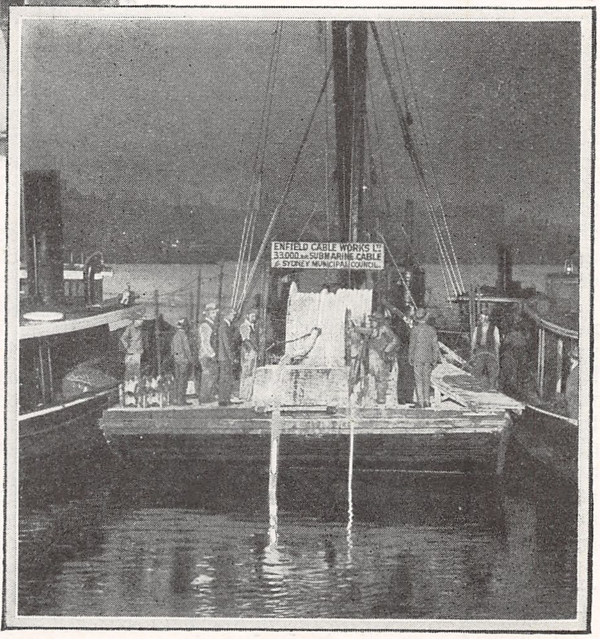
LIGHTS ON POLE AID LAYING OF CABLE

AN ILLUMINATED pole on a barge recently aided in laying a large electric cable at night in the harbor of Sydney, Australia. Electric lights placed at one-foot intervals on the pole made it visible to a surveyor on shore. Sighting through his instruments at it he was able to plot the position of the cable on the harbor bottom. It is necessary to know the exact location of harbor cables so ships will not drop their anchors on them. The pole is seen at the far side of photo at the left.

The unusual engineering feat was performed at night so there would be no interference with shipping. The cable was laid from a barge towed by three tugs. One was lashed on either side and steered it. The other went ahead and set the course. The cable was shipped from England in five reels, each of which contained seven hundred yards of cable and weighed twenty-five tons.



Above, a 700-yard reel of cable. At right, night workers laying cable in Sydney harbor.



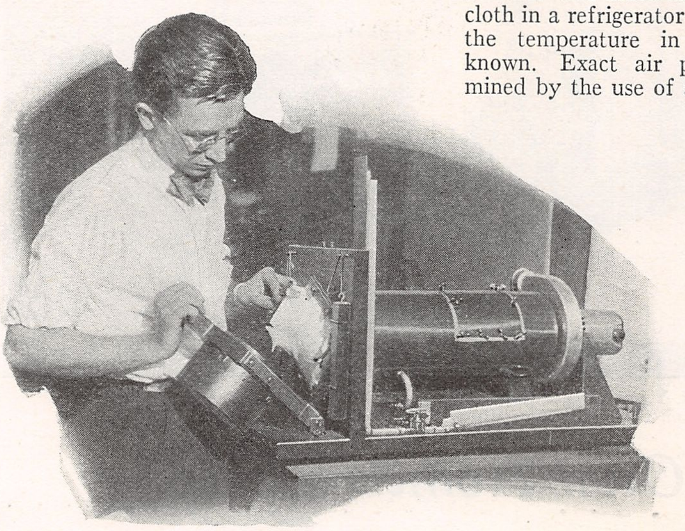
AIR RESISTANCE OF CLOTH NOW TESTED

Underwear will be healthier and outer garments warmer when textile mills adopt an instrument recently developed by the U. S. Bureau of Standards for determining the air resistance of fabrics. Originally, this machine, a short, fat tube with a blower on one end and a flexible fabric holder on the other, was designed to test the air permeability of parachute fabrics.

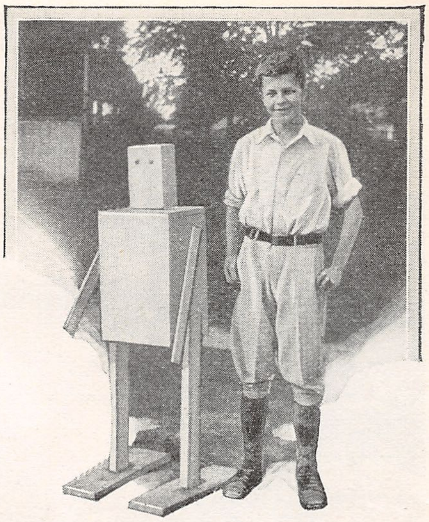
Dr. William D. Appel, chief of the textile division of the Bureau, says that this new device has two important points of superiority over others of like design. First, it is portable and may be moved readily from one department of a mill to another. Second, it draws air through fabrics to be tested instead of pushing it through, thus affording tests with air of a predetermined density and temperature.

Since the air is not first put through the fan, it passes through the fabric at whatever temperature and density may be desired. The machine can be used to test cloth in a refrigerator or in a heated room, the temperature in either case being known. Exact air pressures are determined by the use of a set of nine orifices which are interchangeable. The fabric is held in the air stream under slight tension, the variation in this tension being recorded on scales and indicating the resistance of the cloth sample to the flow of air.

In the accompanying illustration, D. A. Jessup, of the textile division, is shown preparing a piece of fabric for test in the new machine.



D. A. Jessup, of the U. S. Bureau of Standards, is preparing a piece of cloth to test its resistance to air with the Bureau's new machine.



BOY BUILDS ROBOT THAT OBEYS HIS VOICE

Bobby Lambert, thirteen-year-old inventor, has constructed a mechanical "man" in a little home workshop near Charlotte, N. C. He named the creature "Bugs" in honor of his dog. At the word of command, spoken through a dial telephone, Bugs raises his arm.

"Stop," cries his youthful master, and the action ceases.

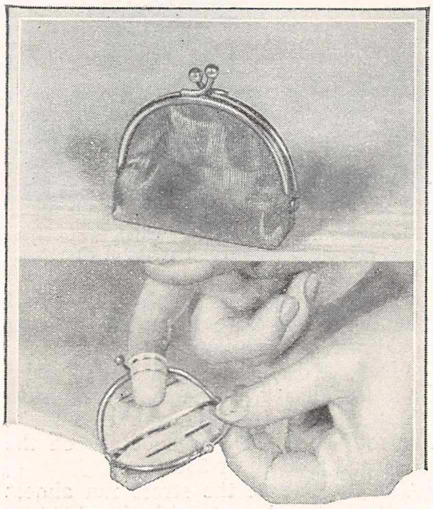
Bobby says that Bugs is only a toy that can merely talk and shake hands. He is, however, experimenting with a system of light rays by means of which Bugs can be more fully controlled.

NEW ZEALAND RIVER IS ELECTRICALLY CHARGED

Horses near a power plant in Christchurch, New Zealand, refused to drink from a near-by river. Investigation showed that an electric line had been grounded on a pipe leading from the river, with the result that the water had become charged with electricity.

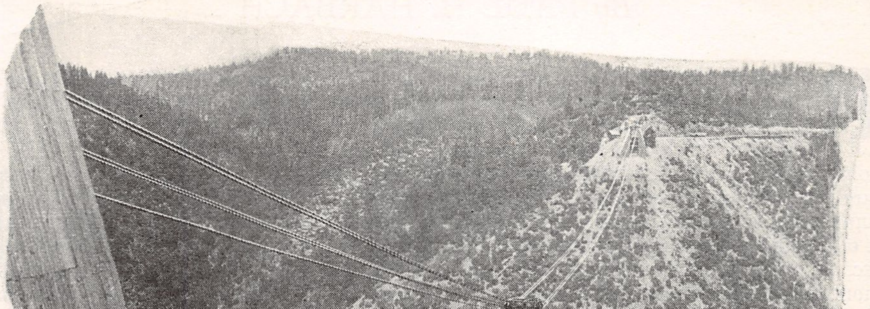
EMERGENCY SEWING KIT

This emergency sewing kit, for a business girl's bag or a traveler's luggage, closes like a small pocketbook. It contains all the materials for rapid mending—thimble, pins, needles, and thread.



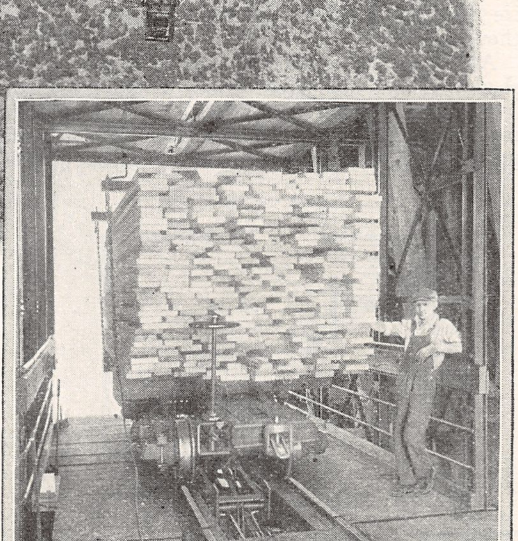
Emergency sewing is provided for with this bag which contains thimble, needles, thread.

ELECTRIC RAILWAY SPANS WIDE CANYON

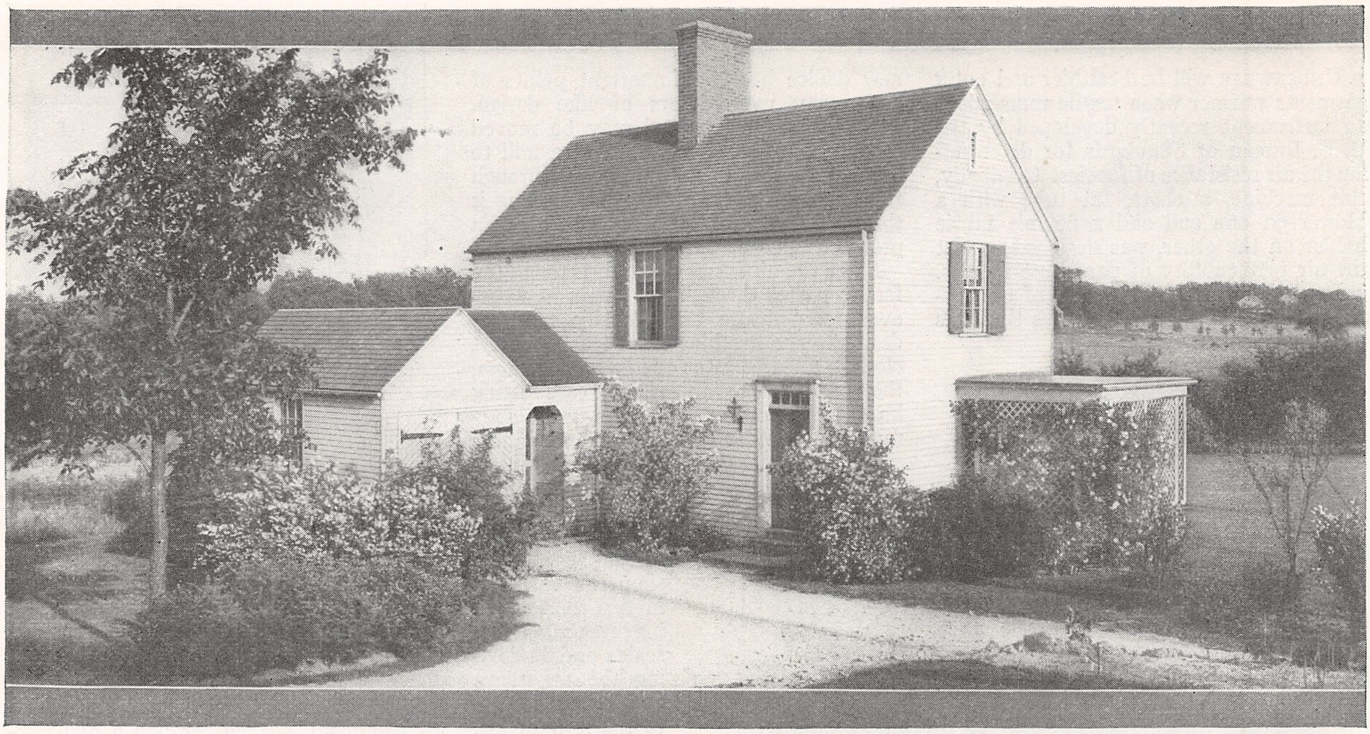


View of the cable-strung electric railway that spans wide California canyon.

A half-mile electric railway in mid-air is the largest one of its kind in America. It was constructed by engineers of a Western lumber company as a means of bridging the canyon between their Camino, Calif., mill and a railway siding. A timber car loaded at the mill runs onto a thirty-two-wheeled carrier hung from four two-inch cables and crosses the chasm at twenty miles an hour. The aerial tramway has proved a speedy and economical means of transporting lumber across the deep gorge.



Car loaded with lumber is ready to start on its trip across canyon on America's largest mid-air railway.



Rear view of house built for himself by Paul H. Harbach, Buffalo, N. Y., architect, who has original ideas as to how a building should be placed on its site. In this case the front of the home faces away from the street, upon which the rear of the house and the garage abut.

The Architect Builds His Own Home—A Series

Don't Let Rules Mar Your House

By PAUL H. HARBACH

REGARDLESS of the dollars involved, it is undoubtedly a great satisfaction to an architect to design his own dwelling. In doing this his mind enjoys a freedom rarely experienced in making designs and supervising work for clients. Momentarily it offers an opportunity for retreat, if not escape, from the conventional and commonplace qualities that so often characterize the lay mind in its home-building thoughts.

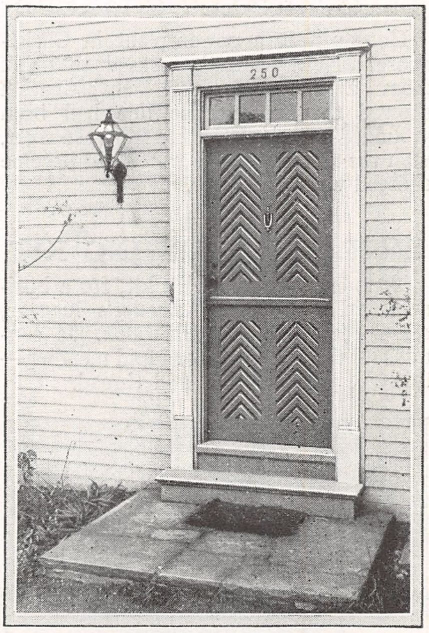
American home-building is still overshadowed and hampered, in my opinion, by the front porch precedents. Without regard to any other consideration, the porch and the chief rooms of the house are too often placed nearest the street. At its worst this has a showcase or goldfish-bowl aspect sometimes approaching the ridiculous.

I believe that a home should be placed upon a site and the location of the various rooms determined without letting proximity to the nearest thoroughfare seriously influence one's decision. In designing a home for my family, it happens that the garage and the rear of the house are nearest the street.

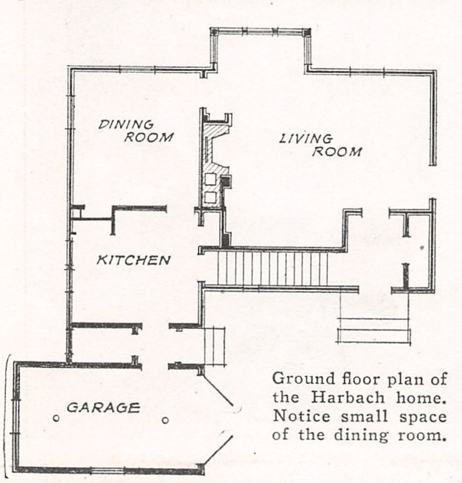
Before going further along this line let us take up the question of selecting a site. In my case I wanted a location that would be far enough in the country to insure fresh air, yet easily accessible to the downtown section of Buffalo, N. Y., where I have my office. Also I wanted one that would have some beauty of topography.

Finally I decided upon a site six miles from Buffalo's city line and twenty-five minutes drive from downtown Buffalo. The lot had a 100-foot frontage on the street and a depth of 350 feet.

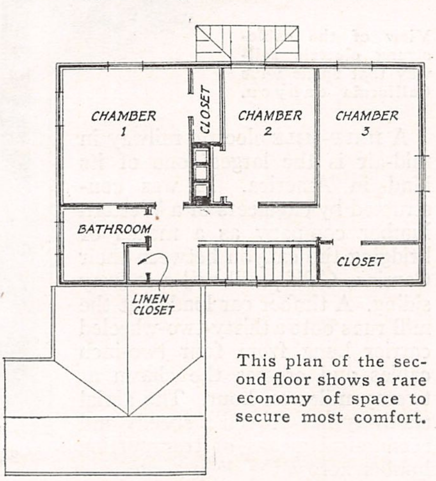
The lot line at the street ran almost exactly east and west, with the street as the northern boundary. From the street,



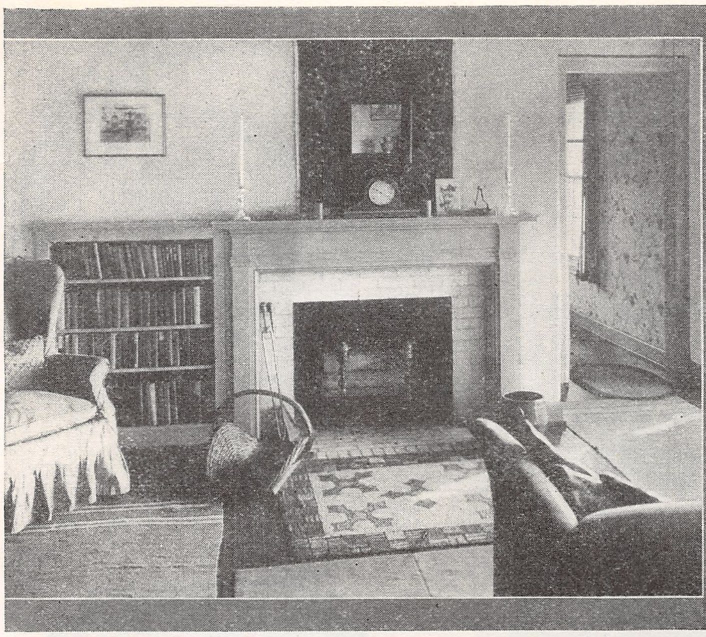
The panels in the main door, which is of white pine, are cut to represent a series of chevrons.



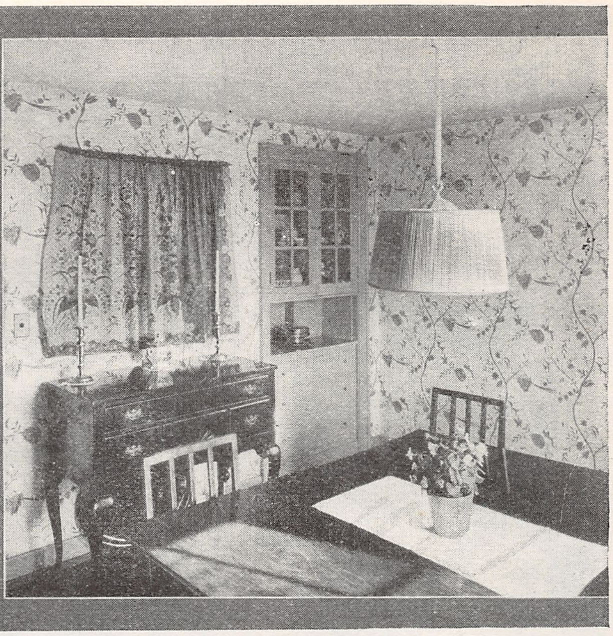
Ground floor plan of the Harbach home. Notice small space of the dining room.



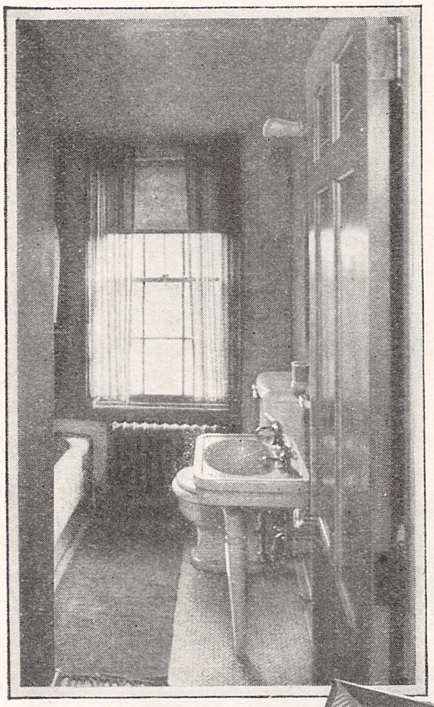
This plan of the second floor shows a rare economy of space to secure most comfort.



The living room is the heart of the Harbach home, and this view of chimney corner suggests skill with which this idea was carried out.



This view of the dining room shows the effect of the early American period which dominates the interior of the house.



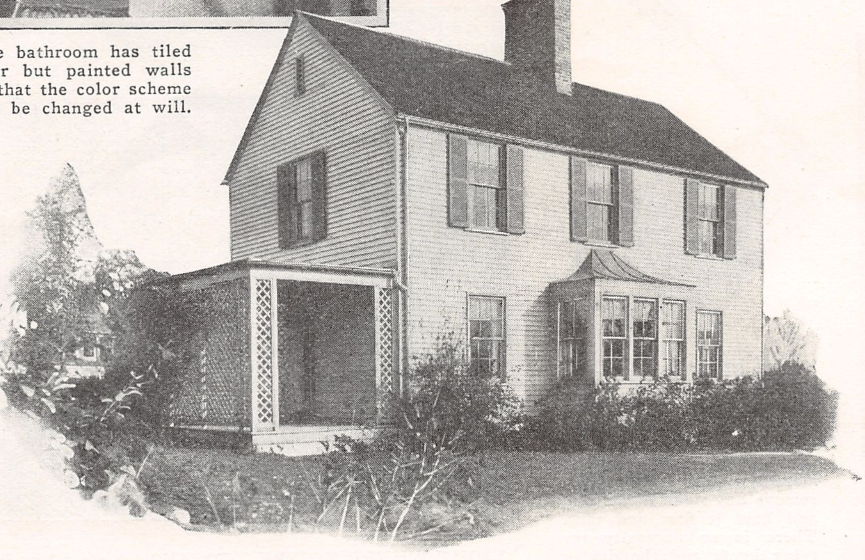
The bathroom has tiled floor but painted walls so that the color scheme can be changed at will.

the lot sloped down gently and at the rear there was a tangle of wild apple trees and shrubbery ending on the bank of a shallow pond.

The property had been part of a farm the owners of which were Quakers who set up several restrictions in the deed for the protection of future home owners.

FOR example, there is a restriction forbidding the construction of house or garage within fifteen feet of either side line of the property or within seventy-five feet of the highway. Single residences only could be constructed. Drilling for gas and oil upon these lots was forbidden to prevent the erection of unsightly well equipment in a neighborhood of home lovers. There is also a clause setting a minimum figure for the cost of the house to be erected.

We wanted to build a house that would be Spartan in its simplicity, but adequate to our needs. Exclusive of the site, we kept the cost within $11,000. In placing the garage on the side facing the street, we reversed the usual order of things, but we wished to make the most of the splendid view toward the rear of the lot. The house is twenty feet by thirty-three feet and the attached garage is ten by eighteen feet.



Here is a view of the front of the house with its many windows looking out upon a southern exposure which, with shrubbery and flowers, has been made attractive.

THE dining room was placed in the southeast corner where the year round it would get the sun during the morning hours. The living room was placed in the south and west end of the house, with a porch on the west end, open toward the south but latticed and now covered with a climbing American Beauty rosebush on the north and west sides. The dining room was made as small as possible, because it is used at most not more than three hours a day, and hence there is no reason for wasting floor space that can be used to better advantage elsewhere on it.

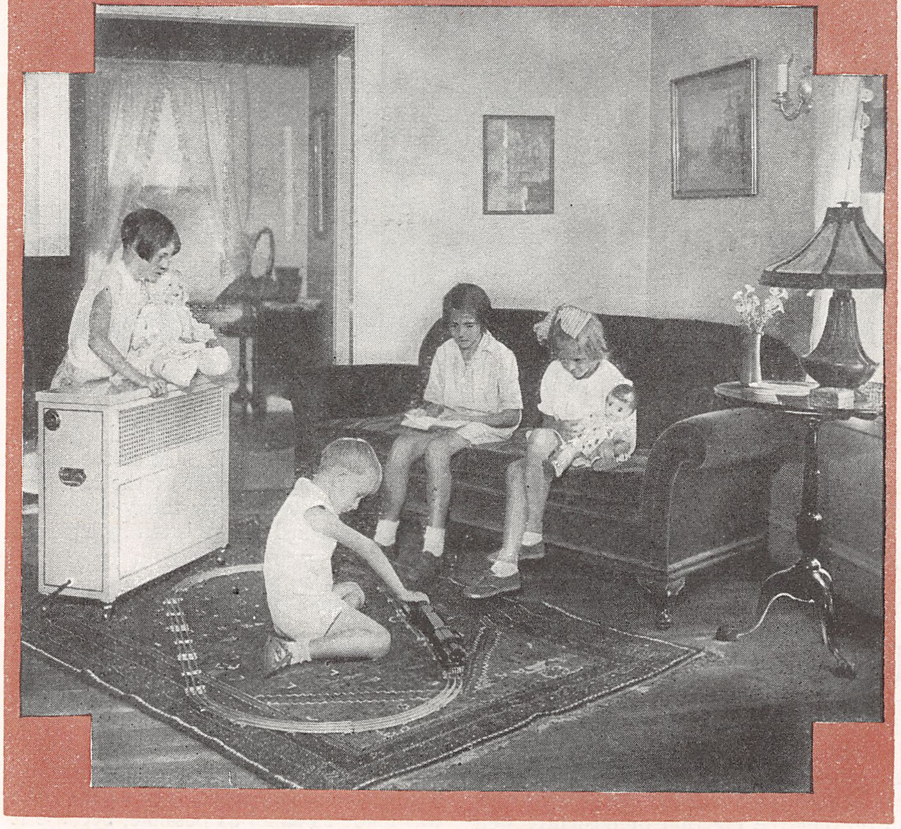
The kitchen, in the northeast corner of the house, has a service entrance through a sort of recess in the connecting portion of the structure between the house and the garage. At the right of this recess are small doors, one opening into a milk box and the second, somewhat larger, opening upon a space for other deliveries. Natural light for the kitchen comes from the east. One may go from the kitchen into the garage through the connecting hallway without going outside. In this hall is placed the first-floor lavatory.

The garage doors, which swing out, are on the west end. A few feet away, on the north side of the house near the west corner, is the main entrance. This entranceway is of narrow clapboards, laid four inches to the weather, painted white. It is derived from an effective one found in an old Dutch farmhouse on Long Island. To the left of it is a bracket bearing a copy of an old English stage lamp of the early eighteenth century.

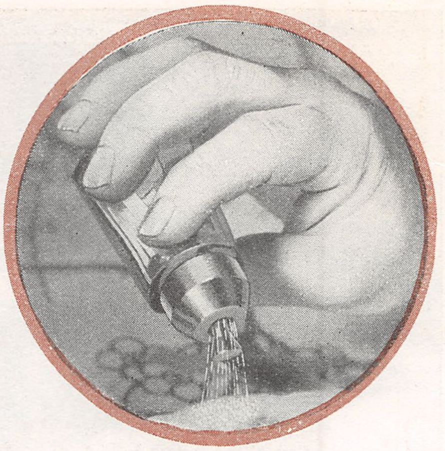
The door, framed with glass above it in four square lights, is of solid white pine, painted a bluish green as are also the window shutters. The door is divided in half in the Dutch manner and in each half there are two sets of vertical panels, so cut that they present a series of chevrons in each panel.

(Continued on page 146)

New Conveniences for the Home



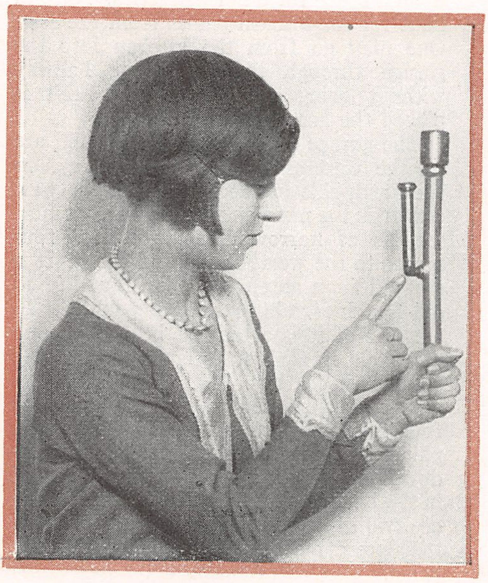
ELECTRIC RADIATOR ON ROLLERS. This portable heating plant is really a steam radiator in which the water is heated with electricity. As the unit is on wheels it can be run into any part of the house where more heat is needed, as pictured above, and plugged into a wall socket. Steam is quickly generated in its tiny boiler and the attractive cabinet design inclosing it directs the warm air outward.

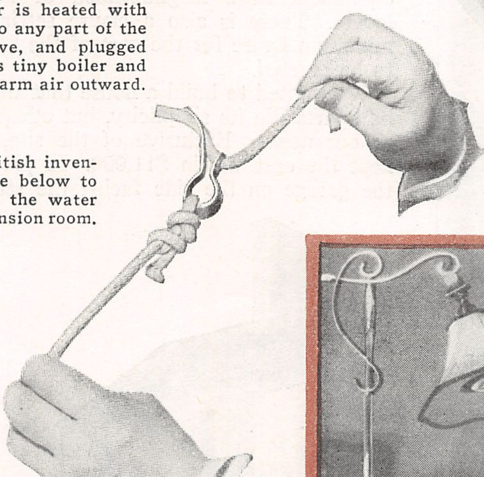


SALT FLOWS FROM THIS SHAKER. Humid weather clogs the average salt shaker so nothing gets out. A cone shaped stopper helps keep dampness out of this shaker. Inverted, it slides out and lets salt escape.

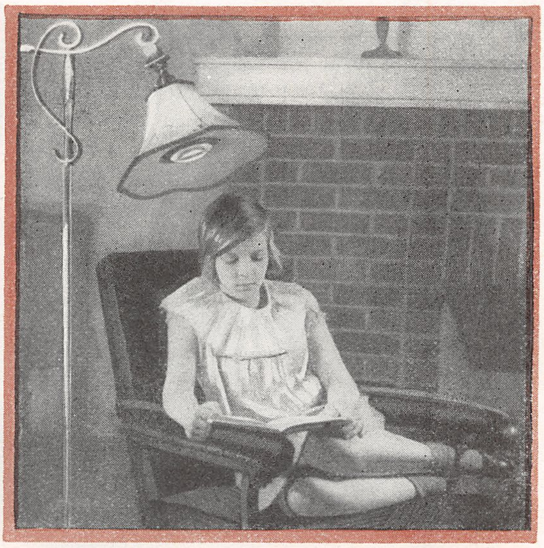
WATCH YOUR WEIGHT. This piece of furniture is not only a comfortable stool but also a scale that weighs you whenever you sit on it.

SAVES FROZEN PIPES. A British inventor has designed the safety valve below to guard pipes from bursting when the water freezes in them, by providing expansion room.

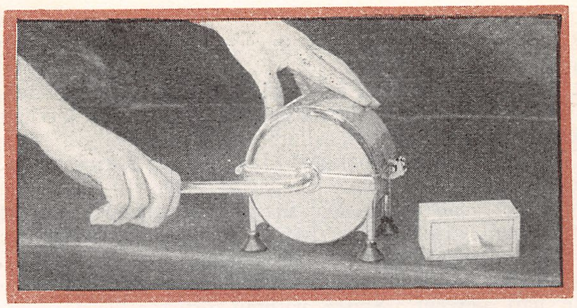




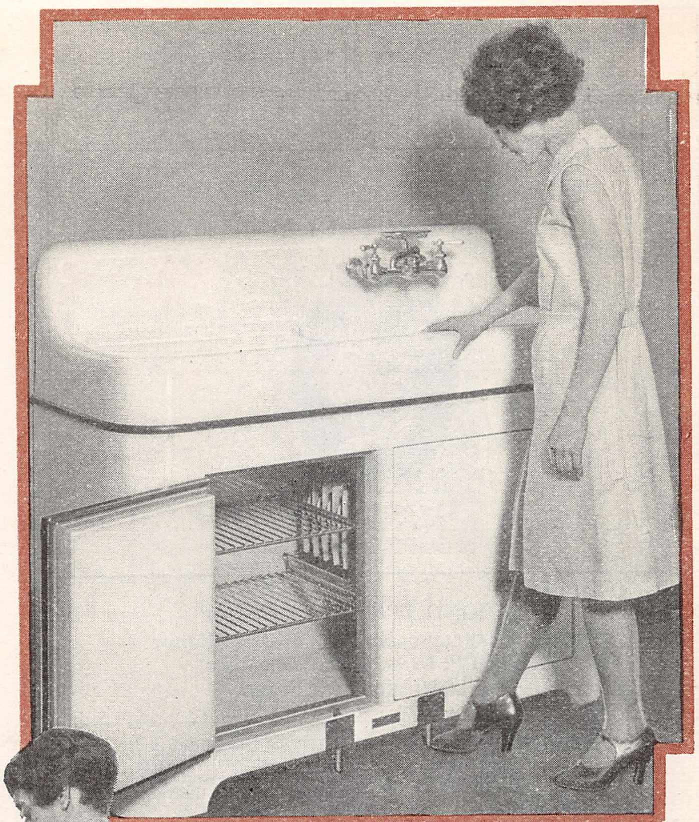
TAKE UP THAT SLACK. Clotheslines have no chance to sag and drag clothes in the dirt if this ingenious metal link, shown above, is used to fasten the ends together. A moment's adjustment will remove any slack in the line and hold it firm and taut. There is no necessity for tying knots and the device once in place cannot slip under strain of heavy clothes.



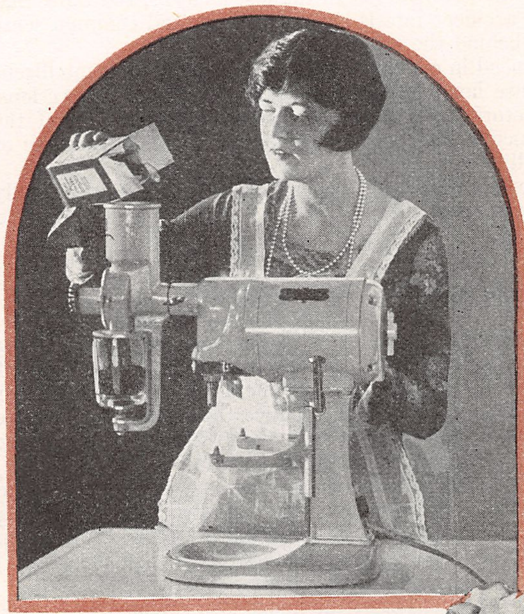
LIGHT WHERE YOU'RE LOOKING. A glass lens in the shade of this reading or sewing lamp directs the beam of light at the exact spot you want brilliantly illuminated.



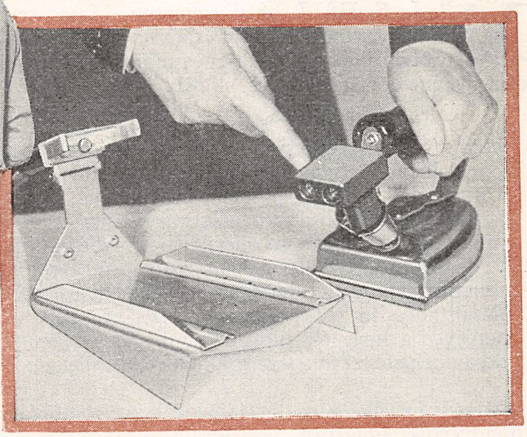
COLOR IT YOURSELF. If oleomargarine is used you can mix coloring powder with it quickly with this mixer.



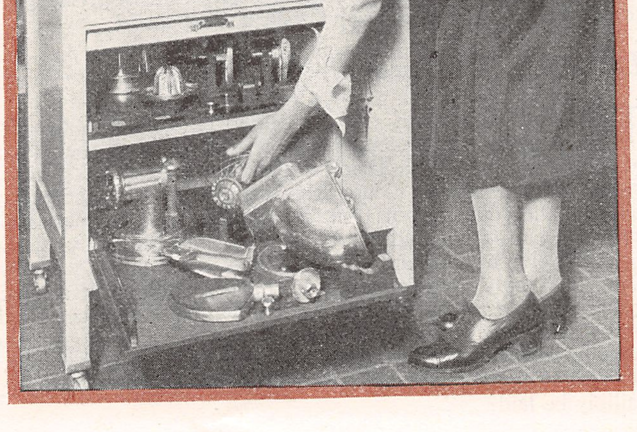
CONVENIENT REFRIGERATOR. If floor space is at a premium, this combination refrigerator and sink will appeal to you. Foot pedals open the doors.



A HANDY SERVANT. Plugged into a wall socket, this electric apparatus will do almost anything asked of it in the kitchen. It will grind coffee and then in an instant will be ready to freeze ice cream or chop meats. Also it is equipped with a removable bowl in which all kinds of beating and stirring can be quickly and thoroughly done. Sixteen inches high, it has three speeds.



NEW IRONS FOR OLD. This little attachment will transform on old-fashioned electric iron into a modern cordless one by feeding current from an electrified stand.



PREPARES FOOD. Built into this electrified kitchen table is a motor that aids in many ways in various details of preparing food. Any one of the appliances shown at the left can be attached to it and used to clean, chop, or pare. Above, the table is shown in use as an ironing board. Connections at the side permit the use of cabinet as breakfast table.

WASH OR DRY CLEAN. By using a fabric bag supplied by the maker, this washing machine can be turned into a dry cleaner.

POPULAR
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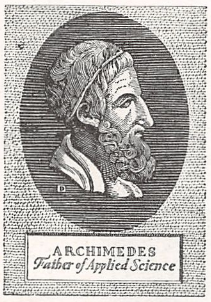

ARCHIMEDES
Father of Applied Science

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, Home Workshop Editor
ALFRED P. LANE, Technical Editor
ISRAEL DOSKOW, Art Editor

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The Truth Yesterday, Today, and Tomorrow

MR. L. S. HALL of Wilmington, Mass., sends us a page advertisement clipped from an old magazine in his files. Set in old-fashioned type and decorated in the manner of a bygone era, it reads as follows:

> "POPULAR SCIENCE MONTHLY for 1886 will continue, as heretofore, to supply its readers with the results of the latest investigation and the most valuable thought in the various departments of scientific inquiry.
>
> "Leaving the dry and technical details of science, which are of chief concern to specialists, to the journals devoted to them, the MONTHLY deals with those more general and practical subjects which are of the greatest interest and importance to the public at large. In this work it has achieved a foremost position, and is now the acknowledged organ of progressive scientific ideas in this country."

Merely by changing the date these paragraphs could be used to advertise POPULAR SCIENCE MONTHLY of today, for the statements therein are true now as they were true forty-five years ago.

Of course POPULAR SCIENCE MONTHLY now is bigger, better, and far more interesting than it was in 1886, but it has, nevertheless, held fast to its original ideals.

Stop the Fool Drivers

EVEN in the early days of motoring, when autos whizzed along at eight miles an hour, and a motor trip was a grand success if the vehicle got home under its own power, there were fatal accidents.

And how the newspapers of that period did welcome every such accident! Invariably they wound up their stories with tirades against the automobile, calling it a menace to civilization—a terrible "Car of Juggernaut" crushing luckless citizens under its wheels.

We wonder what some of these old-timers would say could they look over our shoulder to read a report from the National Safety Council now on our desk. Last year, so the report reads, 32,500 unfortunate citizens were ushered into the hereafter under the wheels of automobiles.

That is equivalent to wiping out the entire population of Lewiston, Me., or Moline, Ill., or Montclair, N. J.

Sad as it is to contemplate such an enormous death list, the most alarming feature of the report is that the number of people killed in 1930 was four percent greater than the number killed in 1929, yet the number of automobiles in use increased by only one percent.

Back of every accident is a record of human failure or misdoing. Even when the primary cause of an accident is a mechanical breakdown, some human is, at least technically, to blame for not knowing the machine would break under a given set of conditions.

There is just one bright spot in this auto accident report. While the country as a whole showed an increase of four percent in the number of accidents, ten states, with relatively strict driver's license requirements, showed an average *decrease* of one and one half percent. States without driver's license laws showed an *increase* of more than eight percent!

The key to the solution of the auto accident problem, we believe, lies in these figures. In the last analysis, the thing that controls the accident rate is the competence and common sense of the man behind the wheel.

What we need in every state are stricter and more intelligent driver's license laws, better facilities for tests and inspections, better inspectors, and, above all, the total elimination of the crook in inspector's garb who passes incompetents for a five or ten dollar bill.

It may be a hardship on the unskillful and temperamentally unfit to deprive them of the privilege of driving—but what a blessing it would be to everyone else!

Little Cameras and Big Pictures

WHEN you take a picture with your camera, the resulting negative consists of an image formed in a thin film of gelatin by millions of tiny grains of metallic silver. The darker portions of the negative which produce the whiter parts of the print have more silver grains than the lighter portions of the negative which form the shadows in the print or enlargement.

What appear to you to be sharp lines in the negative image actually are fuzzy rows of silver grains when viewed under a microscope. That is why it is impossible to get a really sharp enlargement more than a few diameters bigger than the original negative.

The grainy construction of the image also explains why home movie film never gives as clear a picture as you see in your favorite movie house, which uses wider film; and why commercial photographs are taken on such large size negatives.

Photographic chemical experts have long sought to find some way to reduce the size of the silver grains so as to get better detail.

Now along comes Dr. Miller Reese Hutchison, who was for years chief engineer for Thomas A. Edison, with a claim that he has solved the problem that has baffled the experts for so many years.

By treating the negative after exposure and before development with a secret solution, Dr. Hutchison says that the size of the grains is reduced to such an extent that sharp enlargements two feet wide can be made from a negative measuring only half an inch.

Dr. Hutchison seems to be chiefly interested in obtaining a finer grain so as to get a better sound track on motion picture film. This would, of course, be of great importance. But if in actual practice his process lives up to his claims, it will do more than give us better talkies. It will revolutionize the whole art of photography. Every big camera in the country will become obsolete. Commercial pictures will be taken on plates or films only an inch or two wide. Pocket cameras may become no bigger than walnuts and a home movie camera giving good results, may use film no wider than a shoe string.

Let's All Be Morons

TWENTY percent of the people in the United States are morons, according to Arland D. Weeks, Dean of the School of Education of North Dakota Agricultural College. This is merely an estimate. Obviously, the Dean hasn't examined everybody in the country, but from the data at hand he makes his guess. A moron is an adult who has remained, mentally, at the age of twelve or fourteen. But children are notoriously happy. Does this apply to the moron? If so these children of a larger growth may reasonably arouse your envy. On the other hand, has science reached a point where it can accurately gage the mind or is there something subtle and illusive in even the "dull," the subnormal, against which the Dean's yardstick cannot infallibly be laid?

Winners in January "What's Wrong?" *Contest*

FIRST PRIZE 500 DOLLARS

W. V. Chambers, Swarthmore, Pa.

SECOND PRIZE 100 DOLLARS

Leone Goodman, Madison, Wis.

THIRD PRIZE 50 DOLLARS

Fred W. Pickell, Grand Rapids, Mich.

TEN PRIZES OF TEN DOLLARS EACH

S. R. Bachtel, Pittsburgh, Pa.
E. Katskee, Lincoln, Nebr.
W. E. Lang, St. Louis, Mo.
R. F. Lindow, Milwaukee, Wis.
Gail Miller, Christiansburg, Ohio
Marion C. Milton, Galveston, Texas
E. F. Longwell, Brooklyn, N. Y.
Herbert Muench, St. Louis, Mo.
L. H. Roemer, Norwood, Cincinnati, Ohio
Frederick A. Smith, Philadelphia, Pa.

FIFTY PRIZES OF FIVE DOLLARS EACH

Matt Aho, Winton, Minn.
Edward S. Allen, Suffield, Conn.
John Almquist, Chicago, Ill.
Richard R. Almy, North Providence, R. I.
J. Anthoney, Pasadena, Calif.
Norman W. Ashlock, Columbia, Mo.
Elmer B. Benson, Rock Island, Ill.
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Mr. and Mrs. J. F. Chandler, Corliss, Pa.
George L. Clare, Chicago, Ill.
Earl H. Courser, Derby Line, Vt.
Davied Enslee, Morristown, N. J.
Esther W. Farrow, Oak Park, Ill.
J. Ralph Fenton, New Castle, Pa.
Donald L. Hague, Oradell, N. J.
Lena M. Harding, Wildwood, N. J.
Frank K. Helm, Syracuse, N. Y.
Alfonso Hering, Santiago, Chile
M. H. Holroyd, Steubenville, Ohio
Harold L. Johnson, Shavertown, Pa.
M. S. Jones, Royal Oak, Mich.
Mrs. E. P. Lange, Springfield, Mass.
H. H. London, Denton, Tex.
Walter H. Long, Baltimore, Md.
Berchard Mathews, Jermyn, Pa.
Anson R. McConnell, Steubenville, Ohio
Charles E. Milbury, Long Beach, Calif.
Daniel A. Montstream, Hartford, Conn.
Herbert M. Moody, Wytheville, Va.
Larry Moore, Erie, Pa.
H. E. Murdock, Bozeman, Mont.
M. E. Nickols, Frankfort, Ind.
F. S. Olmsted, East Hartford, Conn.
M. B. Parsons, Berkeley, Calif.
W. Prohaska, Carney, Mich.
Royden E. Reed, Manchester, N. H.
William F. Schlesinger, Philadelphia, Pa.
Peter A. Schweitzer, McKeesport, Pa.
R. I. Short, Hazleton, Iowa
Mrs. L. M. Shreve, Farmville, Va.
F. Harold Smoker, Columbia, Pa.
C. H. Spicer, Auburn, N. Y.
Emery Stoops, Sublette, Kansas.
H. C. Stroeher, Casper, Wyo.
S. D. Sweetack, Chicago, Ill.
Robert Warfield, Manor, Pa

COLLECTS DUST OF SHOOTING STARS

Many of the tiny particles of dust that float in the air come from no factory chimney or industrial city. They fall from shooting stars. Thousands of these heavenly visitors, though they fail to reach the earth, sprinkle it none the less with their fragments every day.

Unique among astronomical pursuits is that of Lucien Rudaux, noted French astronomer at the Observatory of Donville, on the French shore of the English Channel. For years he has been collecting this "star dust," and he recently declared that its origin outside the earth is now proved.

At Donville, this scientist collects the microscopic fragments as they settle from the air in a box resembling a weather observer's rain gage. They are recovered even more easily from mountain snow in the Pyrenees, in the south of France, where observers collect the particles for him.

When the pure snow begins to melt, a grayish coating—the dust of meteors—becomes visible on its surface. An observer collects this dust by running a quantity of the melted snow through a porous filter paper, the dust remaining on the paper.

Examined under a microscope, the particles seldom exceed a hundredth of an inch in size.

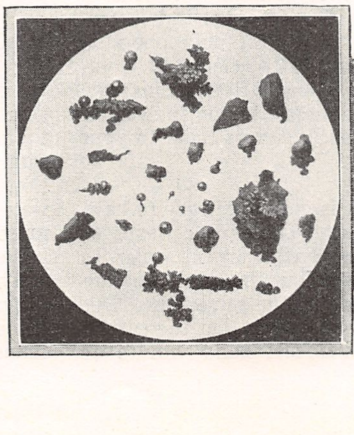
Shooting stars with luminous tails of dust.

Most are much smaller. Among the interesting shapes they assume are globes and tear-shaped drops, suggesting the terrific heat that must have melted them as the parent body fell. This identifies them as fragments that a shooting star threw off. Tested with a magnet, many of the particles adhere to it. These contain iron and iron-nickel alloys, which would be expected in a meteoric body.

Especially plentiful recoveries of this odd "star dust" have followed the periodic meteor showers that astronomers expect each year.

Once an enormous meteorite whizzed close to the observatory at Donville. Two days later a shower of microscopic particles settled upon the collecting box of the observatory, so thickly that they could be seen with the naked eye. They had been left floating in the air by the meteorite.

This astronomer's observations leave no doubt that shooting stars, or meteors, are of exactly the same nature as meteorites. The only difference is that meteorites reach the earth, while meteors are consumed in the upper air by the heat generated by atmospheric friction and only their dust descends to the earth.



Collecting meteor dust by melting and filtering snow. At left, star dust as it appears beneath the microscope.

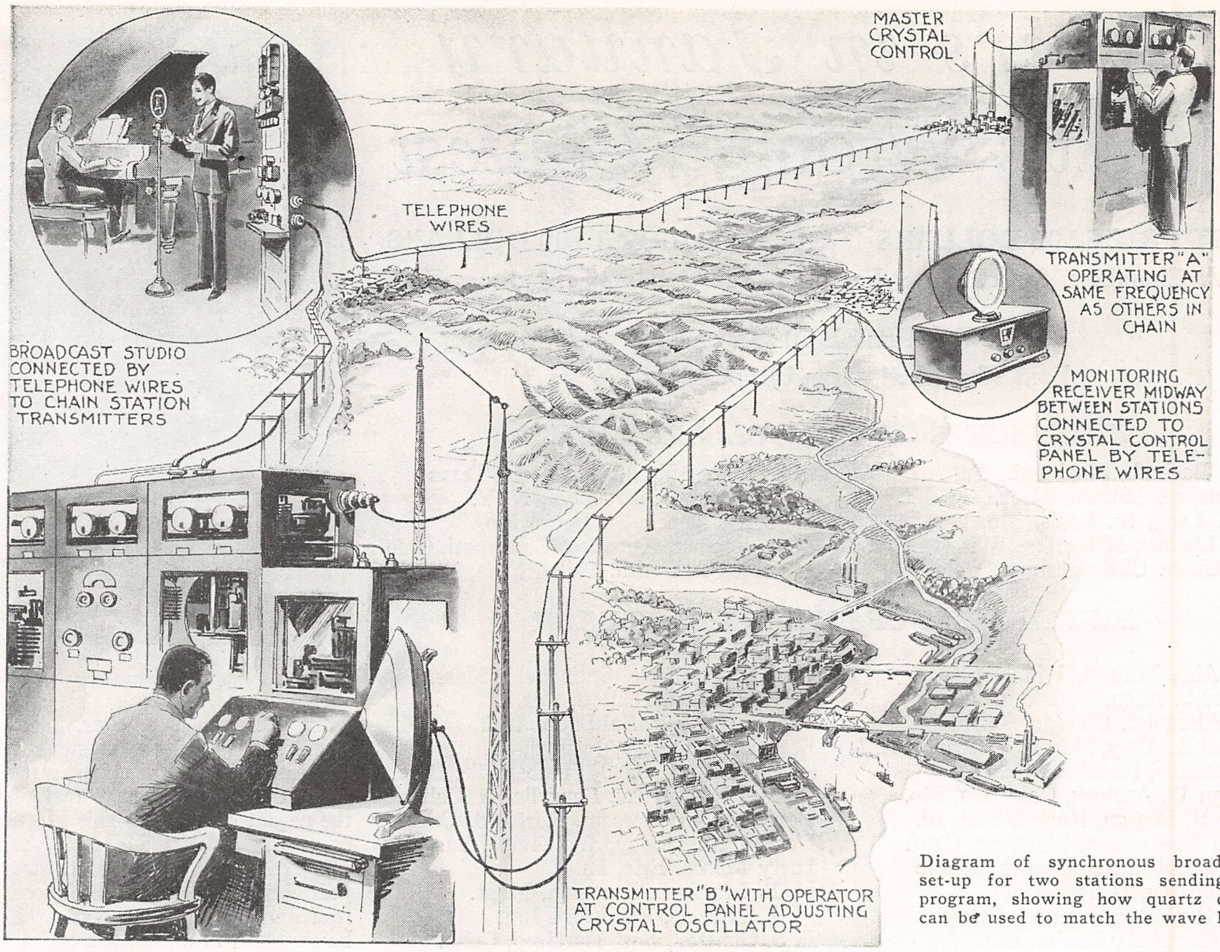

MASTER CRYSTAL CONTROL
TELEPHONE WIRES
TRANSMITTER "A" OPERATING AT SAME FREQUENCY AS OTHERS IN CHAIN
MONITORING RECEIVER MIDWAY BETWEEN STATIONS CONNECTED TO CRYSTAL CONTROL PANEL BY TELEPHONE WIRES
BROADCAST STUDIO CONNECTED BY TELEPHONE WIRES TO CHAIN STATION TRANSMITTERS
TRANSMITTER "B" WITH OPERATOR AT CONTROL PANEL ADJUSTING CRYSTAL OSCILLATOR

Diagram of synchronous broadcasting set-up for two stations sending same program, showing how quartz crystals can be used to match the wave lengths.

Chain Broadcasts on *One Wave* Is *Latest* Radio Plan

By JOHN CARR

A REVOLUTIONARY change is impending in radio broadcasting. Stations you now hear at certain points on your dial will disappear from their accustomed places and new stations will fill the gaps. No longer will the same program come from dozens of different stations each on a different wave length. Chain programs will be received with satisfactory volume by listeners who now hear them faintly, if at all.

These changes will come through synchronous broadcasting—a system that permits two or more stations to transmit the same program at the same time on the same wave length.

Chain broadcasting has brought the need for synchronous operation. At present between five and seventy-five of the precious ninety-six waves that are available often are employed in sending out a single program. Engineers long have wanted to eliminate this wasteful method. They knew that stations transmitting the same program ought to transmit on the same wave and have devised several systems of practical synchronous broadcasting.

When a radio broadcast transmitter is in operation, it sends out a high frequency electrical carrier wave, and it is the frequency with which the electrical tension changes—or, in other words, the rapidity of its vibration—which governs the wave length. When you tune in your radio receiver, you set it so that it responds to this frequency.

The much slower audible vibrations of the human voice or of a musical instrument are converted by the microphone in the studio into equivalent electrical vibrations. These vibrations, after considerable amplification, are impressed on the carrier wave, which literally carries them to your radio receiver.

IN THEORY it is only necessary to have two stations send out carrier waves of exactly the same frequency in order to permit both to send out the same program on the same wave at the same time. But when you stop to consider that the carrier waves in the broadcast band vibrate or oscillate at speeds ranging from 550,000 times a second up to 1,500,000 times a second, you can realize what a tremendous job it is to keep the frequencies of the two stations exactly the same. Any difference, even as little as fifty or one hundred cycles a second, which would be a microscopically small percentage of error, would cause interference between the two carrier waves and make hash of the voice or music.

DOUBTLESS you have noticed newspaper reports in the past telling of the refusal of the Federal Radio Commission to renew some broadcast station's license because of "off-wave" transmission. As the Commission permits a deviation of 500 cycles, the difficulties in the way of holding to a specified frequency must be obvious, since no station would knowingly operate off-wave.

The use of quartz crystals has solved the problem of controlling oscillation to a precise frequency. A quartz crystal, when connected to *(Continued on page 147)*

Build *Your Own* Private Radio Set for $12

POPULAR SCIENCE MONTHLY Blueprint No. 130 describes in great detail the construction of this set. It includes instructions for winding the tuning coils. A list of parts approved by the Popular Science Institute is included with each blueprint. This list also will be mailed without charge to readers who wish to work from this article without ordering the blueprint. Address Technical Editor, Popular Science Monthly, 381 Fourth Ave., New York.

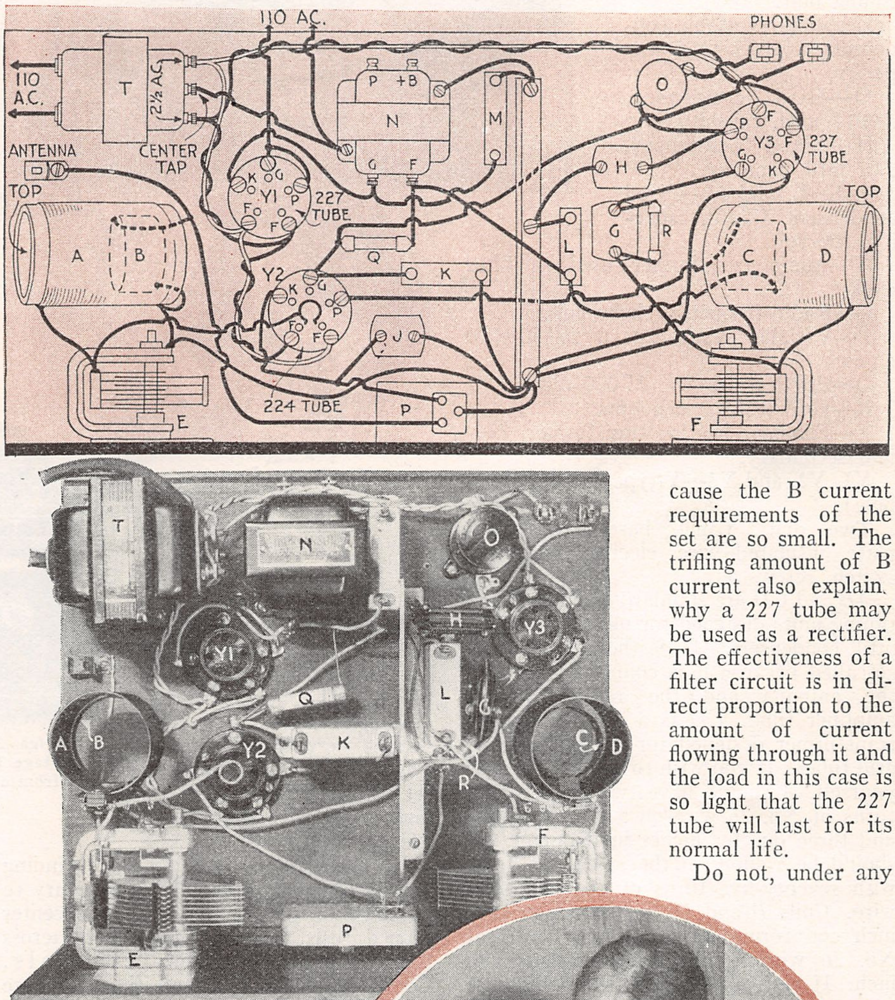


Fig. 1. At top, picture wiring diagram and below it top view of set showing position of wires and parts.

By ALFRED P. LANE

HERE is a novel little radio receiver you can build yourself for your own personal use. It operates directly from the light socket and will give headphone reception of ample volume on all local and many distant stations. Since it brings the broadcasting to you by way of headphones instead of a loudspeaker, you can use it anywhere at any hour of the day or night without disturbing anyone, not even those in the room with you.

If you have this set, you do not have to listen to programs someone else is anxious to hear over the regular family set. The headphones, shutting out the noise from the loudspeaker, will let you hear the program that particularly interests you.

Designing the set for headphone use only allows a remarkably simplified circuit with corresponding economy in cost of construction. Just three tubes are used. One is a type 224 screen grid tube that functions as a radio-frequency amplifier. The others are type 227 A. C. heater tubes, one a detector and the other a rectifier to supply the moderate B current requirements of the circuit. No high voltage transformer is used and the filter circuit is of the simplest description.

Most radio experimenters who have the usual collection of miscellaneous parts on hand left over from previous work will find that they have practically everything needed to build this set.

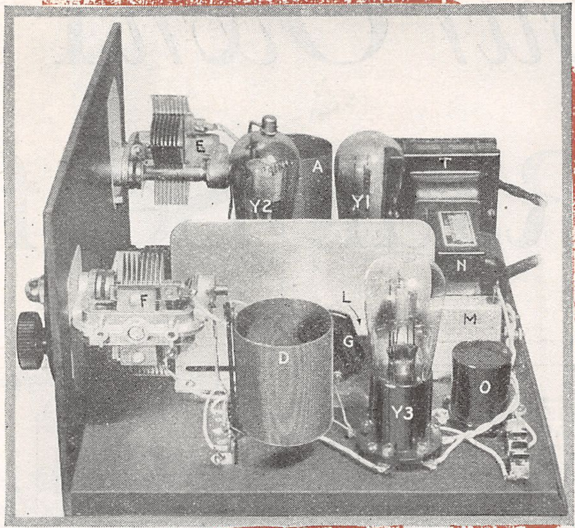
Even if you have to buy every part, the cost may be as low as twelve or fifteen dollars if moderate priced parts are used and not over twenty-five dollars if you insist upon having the finest parts obtainable.

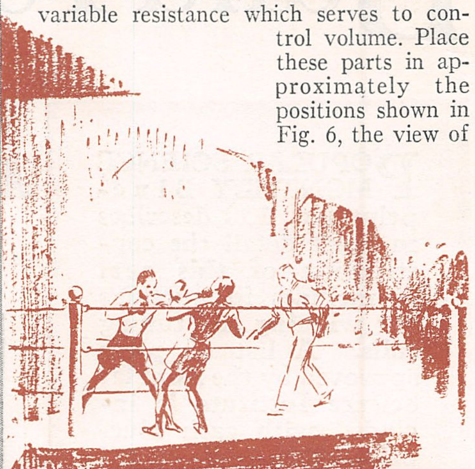
The size of the panel on the receiver shown in the illustrations is seven by twelve inches, so that the receiver does not occupy much space. It weighs twelve pounds complete. With care it should be possible to make this set smaller in every dimension if portability is important. The height is, of course, limited by the height of the screen grid tube in its socket.

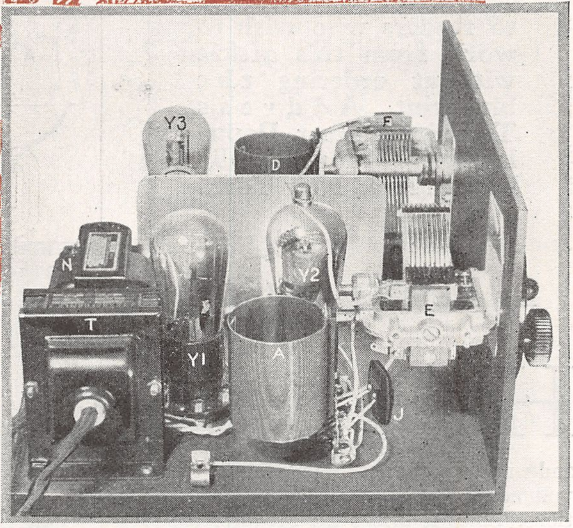
In spite of the simplicity of the filter circuit which takes the raw alternating current from the electric light line and transforms it into smooth direct current suitable for the B circuits of the set, there is practically no hum. This is because the B current requirements of the set are so small. The trifling amount of B current also explain. why a 227 tube may be used as a rectifier. The effectiveness of a filter circuit is in direct proportion to the amount of current flowing through it and the load in this case is so light that the 227 tube will last for its normal life.

Do not, under any

Fig. 2. The front panel is here seen fitted to the baseboard and the wire connections are being soldered to sockets.







Figs. 3 and 4. At top side view showing detector stage tuning unit in foreground. Above is a view from other side with radio-frequency unit in place.

circumstances, attempt to add another tube to this circuit to get loudspeaker reception. A severe hum would result and neither the 227 tube nor the secondary winding of the audio transformer used at N would stand the extra load.

Here are the parts you will need to build the set:

AB — Radio-frequency stage tuning unit.

CD—Detector stage tuning unit.

E and F—Variable condensers, .00035 mfd. capacity.

G—Grid condenser, .00015 mfd. capacity.

H—Fixed condenser, .002 mfd. capacity.

J, K, L, and M—Fixed condensers, 1 mfd. capacity, 200-volt.

N—Audio transformer used as filter choke.

O—Radio-frequency choke coil.

P—Variable resistance, 0 to 500,000 ohms.

Q—Fixed resistance, 25,000 ohms.

R—Grid leak, 2 megohms.

T—Filament heating transformer, 2½-volt secondary.

Y1, Y2, and Y3—Y-type sockets (five-hole).

Two dials, panel, baseboard, shield plate, insulated wire, electric light cord switch, screws, etc.

AB and *CD* are standard factory wound tuning units designed for use with .00035-mfd. condensers. *AB* is the antenna coil, so-called because it is connected between the antenna and the radio-frequency amplifier tube. *CD* is a radio-frequency transformer designed for use with screen grid tubes. If you wish to wind these coils yourself, *A* should have twelve to fifteen turns of No. 26 wire on a coil form one and three quarter inches in diameter. *C* should be wound on the same size form with seventy-five turns of the same size wire. Coils *B* and *D* are wound on two-inch coil forms with eighty-six turns of No. 26 wire spaced thirty-six turns an inch. If you cannot space-wind them use four or five less turns and wind the turns against each other.

E and *F*, the tuning condensers, may be of any style or make provided the maximum capacity is as specified.

Be sure that fixed condensers *J, K, L,* and *M* have a rated working voltage of not less than 200 volts.

The audio transformer *N*, the secondary circuit of which is used as a filter choke coil, may be of any make. Any old audio transformer you have on hand will do nicely provided the secondary winding is in good condition.

Transformer *T*, which supplies the two-and-one-half-volt current to heat the filaments of all three tubes, should be rated to handle at least that many tubes. There are several different makes of these small transformers, most of them rated for from six to ten tubes.

It is possible to use a toy transformer at this point in the circuit provided it can be set to give exactly two and one half volts as determined by an accurate A. C. type voltmeter. Merely setting to the scale on the toy transformer is not sufficient. The actual voltages developed by a toy transformer may be off in voltage sufficiently to render the set inoperative or, if too high, seriously shorten the life of the tubes.

If the two-and-one-half-volt winding has no center tap, it will be necessary to purchase a ten or twenty ohm center tapped resistance and connect it across the two-and-one-half-volt terminals. Connect the center tap of the resistance as indicated for the center tap of the winding.

Note that there is a metal plate arranged at right angles to the front panel to shield the detector circuits from the radio-frequency stage. Any metal except iron can be used for this plate. Its size is not critical. Make it about the size indicated in the illustrations. It can be left out entirely with only a slight sacrifice in signal strength.

This set has been tested and approved for home construction by the Popular Science Institute.

After you have all the required parts, the first job is to drill the front panel, which may be of composition or wood, to mount the variable condensers and the variable resistance which serves to control volume. Place these parts in approximately the positions shown in Fig. 6, the view of the front panel. Next fit the front panel to the baseboard and then mount all the parts on the baseboard following the arrangement shown in Fig. 1, the top view.

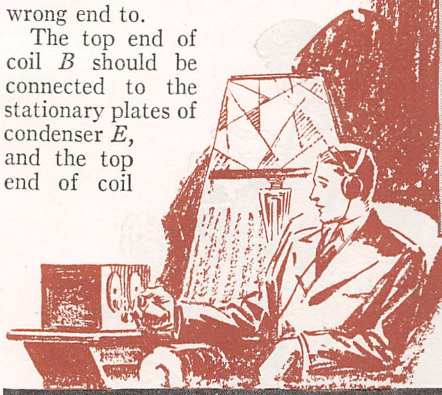
After fitting the parts in place you are ready to start wiring, beginning with the filament heating circuit. This, as Fig. 1 (the top view and picture wiring diagram) shows, is made up of two wires twisted together to form a cord leading from the transformer terminals to the F terminals of the sockets. The wires are twisted together in this way to prevent a capacity effect that would cause a hum.

Be sure to study Fig. 1, the picture wiring diagram, or Fig. 7, the theoretical diagram, and follow these diagrams as closely as possible. As you put in each wire, check it off with a pencil on the diagram so that none will be overlooked. After you have finished the wiring, rub out all the pencil marks and check each wire again to make sure that you have everything right.

Note that the metallic shielding plate, the casings of condensers *J, K, L,* and *M*, and the metal frame of audio transformer *N* should all be metallically connected together. The receiver operates without any ground connection. No ground should be used, as it would cause a short circuit with the 110-volt light line.

In the picture wiring diagram, Fig. 1, you will see that the tuning units *AB* and *CD* have been tipped over so that you can see the exact connections to the coils. The direction in which the wire is wound in these coils is not important, but the coils must not be connected wrong end to.

The top end of coil *B* should be connected to the stationary plates of condenser *E*, and the top end of coil *D* should be connected to the stationary plates of *F*. Note particularly the connections to coil *C*. The plate terminal of socket *Y2*, the screen grid tube socket, should be connected to the bottom end of this coil.



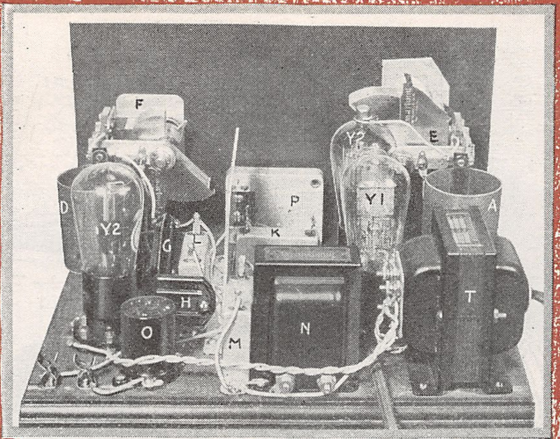


Fig. 5. Rear view with filament heating and audio transformers on right and radio-frequency choke coil and bulb socket at left.

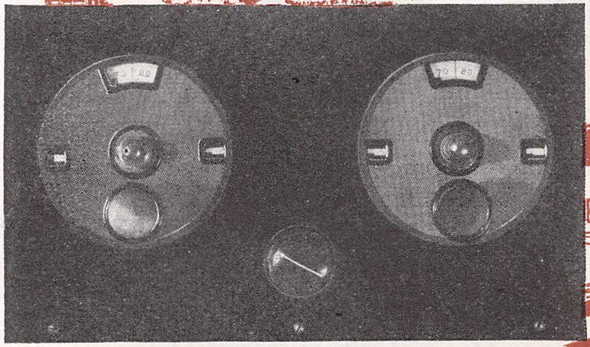


Fig. 6. View of the front panel after variable condensers and variable resistance have been mounted in place.

It is not necessary to purchase any special cap connection for the cap on the screen grid tube in socket *Y2*. As shown in Fig. 1, this can be a piece of flexible wire with a loop formed in the end to fit over the cap and the other end connected to the stationary plates of condenser *E*.

Figure 1, the picture wiring diagram, shows two sets of wires which must be connected to the 110-volt A. C. light line. Two pieces of drop cord should be used to make these connections. One piece should be long enough to reach the socket and the other a short piece that can be spliced into the long one.

The cord on the two-and-one-half-volt transformer supplies the long piece. Fit a through cord switch in this cord so that you can turn the set on and off without pulling the plug out of the socket. It is not advisable to wire the 110-volt circuit to a switch on the front panel as, in an unshielded circuit of this type, there would be a chance for a hum due to the capacity effect.

After the wiring is complete and you have carefully checked it, place a 227 tube in socket *Y1*, a 224 tube in socket *Y2*, and a 227 tube in socket *Y3*.

Next connect the antenna to the binding post or spring wire clip at one end as indicated in Fig. 1, the picture wiring diagram, and connect the headphone cord tips to the binding posts at the back of the set as indicated in this same diagram.

If you only want to hear local stations a few miles away, you can get excellent results with an indoor antenna ten or twenty feet long strung around the picture molding. If you want distance, put up a good outdoor antenna from fifty to 150 feet long depending on how far you are from the station and the intensity of reception in your particular neighborhood.

Make sure that the antenna is well insulated as, in this circuit, if the antenna becomes short circuited, either the fuse will be blown, the tube in socket *Y1* destroyed, or the secondary winding of audio transformer *N*, the filter choke, burned out. If there is any doubt about the antenna put a fixed condenser of any capacity from .005 mfd. up to .1 mfd. in series with the antenna lead. This is a wise precaution even if the antenna is well insulated and will not have the slightest effect on the quality of reception.

When everything is ready turn on the current and then wait for about half a minute to be sure the tubes are properly heated. Now try the volume control. You will find that turning the knob too far one way will produce a squeal if the two dials are tuned to the same wave length. Turn the knob back from this point and carefully turn the dials till you locate the stations you want.

In tests at the Popular Science Institute radio laboratory it was found that all the powerful near-by stations could be brought in with only a piece of wire strung around the room. The volume on the headphones was adequate. When tested on a good outdoor antenna the volume from these stations was uncomfortably loud at maximum setting of the control.

It is also possible to get reception without any antenna by substituting a ground connection instead. In this case one terminal of a .0001 to .0005 mfd. fixed condenser is connected to the antenna binding post and the remaining terminal of the condenser is grounded on the water pipe in the usual way. In some cases reception by way of the ground causes a slight hum, so the best arrangement where an outdoor antenna is impossible is the indoor antenna. Note that it is desirable to use a .005 to .1 mfd. condenser in series even with an indoor antenna to prevent any possibility of a short circuit.

Undoubtedly many readers will desire to build this receiver as a portable outfit because of its light weight and simplicity. Assuming that the general arrangement of the apparatus is retained, it is possible to make several minor changes to save space. The socket *Y2* may be placed so that the type 224 tube is horizontal to save height. The condensers could be mounted with the shafts vertical, using a top panel.

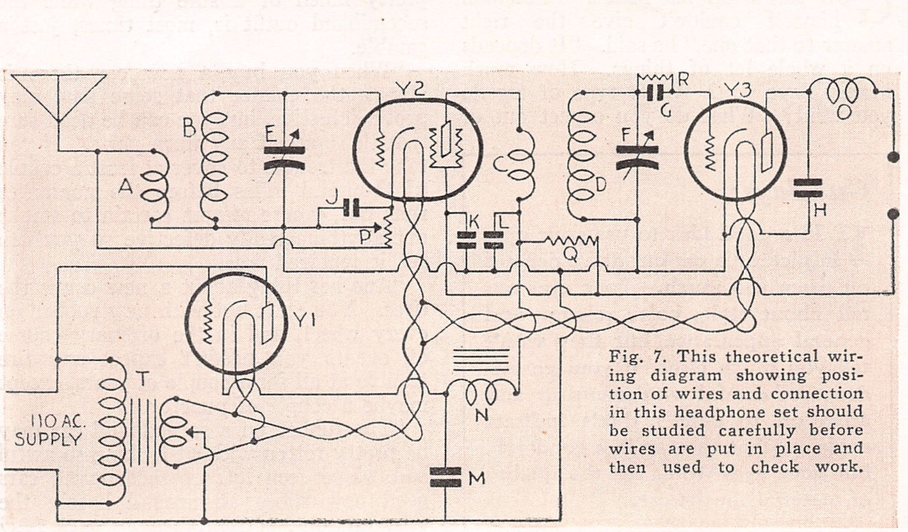
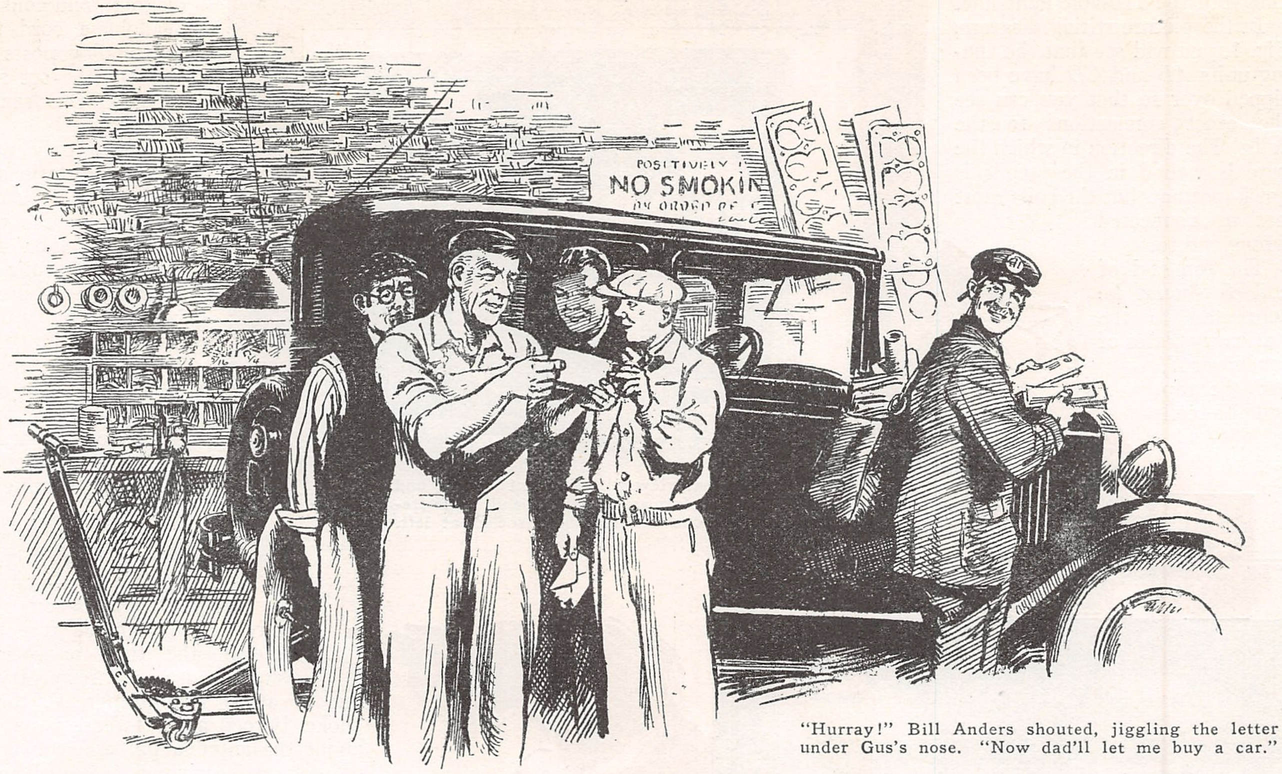


Fig. 7. This theoretical wiring diagram showing position of wires and connection in this headphone set should be studied carefully before wires are put in place and then used to check work.



"Hurray!" Bill Anders shouted, jiggling the letter under Gus's nose. "Now dad'll let me buy a car."

Gus Gives Pointers on Car Buying

Veteran Mechanic Talks of Secondhand Autos and Shows How Real Bargains Are Sometimes Possible

By MARTIN BUNN

"GEE WHIZ!" exclaimed young Bill Anders as he gazed longingly at the shiny new automobile. "I just wish I had a car like that!"

"It'd suit me right down to the ground, too," echoed Ted Anders, Bill's younger brother.

Gus Wilson, veteran auto mechanic and half owner of the Model Garage, looked at them critically.

"You young scalawags'll never get a car like this just by wishing," he grumbled as he lowered the hood and snapped the catches. "Instead of hanging around here under my feet all the time, why don't you earn some money so you can buy one?"

"I do earn money," young Bill indignantly protested. "I've got enough saved up already to pay my way through college next year."

At that moment the postman poked his head in the door and handed several letters to Gus.

"You might as well take this and save me stopping at your house," he said, thrusting a letter into Bill Anders' hand.

Joe Clark, Gus's partner, stepped out of his little office to get the mail just in time to hear Bill let out an excited yell.

"Hurray!" he shouted, jiggling the letter under Gus's nose. "I've won the scholarship! Now dad'll let me use that money to buy a car! What kind of a car shall I get, Gus?"

"Well," Gus grinningly observed, "if you're like the rest of these collegiate birds I see round here, you'll collect a rattling heap of tin."

"Not for me," said Bill firmly. "I want a real car and then I want to keep it in tip-top condition. Do you think I'd do better to buy a good secondhand car instead of a new one?"

GUS threw up his hands. "Solomon himself couldn't give the right answer to that one," he said. "It depends on a whole lot of things. How much money have you? What type of car do you want? What do you expect out of a car? How much do you expect to use it? Even with all those questions answered, there's still plenty of room for argument. About all I can do is to line up some of the things you'll have to figure on and let you decide for yourself."

"FAIR enough," said Bill. "Just tell me the arguments both ways. That'll give me something to go on."

"To begin with," said Gus, "the main difference between buying a new car and a secondhand bus is that the new one is pretty much of a sure thing while the secondhand outfit is, most times, just a gamble.

"When you buy a new car there is always the chance that some part may prove defective, but you can be dead sure that there aren't any worn parts. If you take the trouble to cover at least a couple of thousand miles before the guarantee runs out, you're almost certain to smoke out anything really defective so you can get it replaced free.

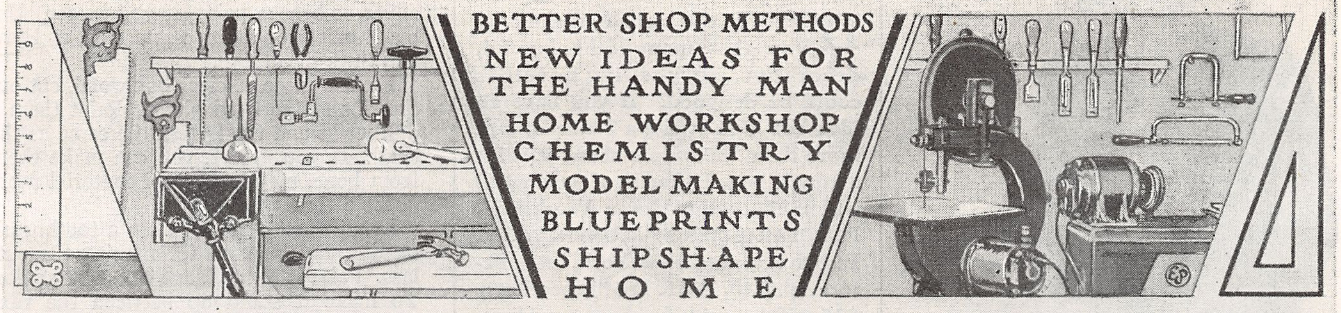
"Another thing about a new car is the tires. You start out with new rubber on every wheel, and in the ordinary course of events you needn't expect any tire trouble at all for a couple of years, except maybe a couple of punctures.

"The rubber on a secondhand car may be pretty rotten without looking so awful bad. I've seen lots of secondhand cars need new shoes all around before the year was out. *(Continued on page 149)*

Gus Says:

IT IS a good idea to use your eyes in picking a car but don't depend on them too much. Your eyes can tell about style, color scheme and general appearance, but they won't tell you much else. If you see evidence of careful workmanship and attention to details that's indirect evidence that the car is a good job, but your eyes won't tell the quality of materials in the car.

THE HOME WORKSHOP



Treasure Island Smoker's Tray

By

CHARLES H. ALDER

HOW would you like to make a new kind of smoker's tray—one that tells a story? A story of the days of pirates, of gold and jewels, of shipwreck, of adventure and death?

All right, here's a tray that does just that! Made in tableau form, it depicts the sandy beach of some far distant tropical island in the South Sea with a wrecked boat, a pirate's weather-beaten, iron-bound, oak chest, an old headless wine cask, the skull and ribs of a dead pirate, and the cutlass that pierced his heart.

What a bloodcurdling yarn you can invent to explain these relics! But don't stop to do it now; just get out your tools and start to work.

The chest is merely a small box with a rounded top cut from a solid piece. Any small scraps of soft wood or pieces cut from a thick cigar box may be used, but they should not be thinner than 1/4 in. Mark the plank divisions with a pencil and trim out the grooves with a knife or a chisel, or use a file, if you prefer. To imitate a weather-beaten appearance, use a wire brush and rub the wood vigorously with the grain. Then apply a coat of fumed oak or other dark stain of either the alcohol or water type. If you wish to use an oil stain, the staining will have to be left until after the bands are glued on; and you will have to be careful not to allow any surplus glue to get on the exposed wood, or the stain may not "take."

The next step is to glue on the "iron" bands, which are of cardboard. Then cut pins to the correct length—about 1/8 in.—for studding the chest, and hammer them in lightly, after first making small holes with an awl.

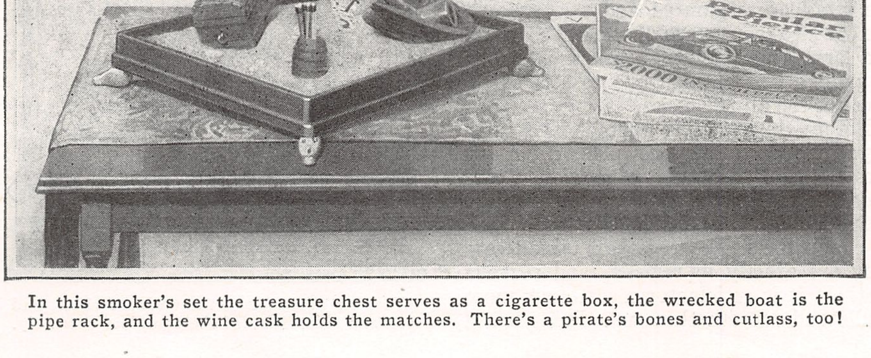
To make the iron rings for the handles, wrap a piece of wire several times around a large nail and saw the wire lengthwise of the nail. Then remove the rings and hammer and file them to shape. Use pins for making the two staples to secure the rings to the chest.

The hinges are merely four long staples, also made from pins; these are hammered slantwise into the hinge edges of the chest as shown. A small chain is fastened inside to prevent the top from going too far back and coming off its hinges.

Now go over the bands with the fumed oak stain. You may stop here if you wish, but it is better to apply a coat of dull varnish and then rub it down with a mixture of rottenstone and liquid wax; or use shellac in place of varnish and finish with the rottenstone and wax.

The barrel or wine keg is a large spool. Trim out the inside with a knife from both ends until the hole is as large as necessary. Then whittle the outside to the shape of a barrel, and file and sandpaper it smooth. Draw the staves on the outside with a pencil, and use a knife or file to make the grooves. Mark the staves on the inside by the same procedure. Wire-brush the barrel lengthwise of the staves, apply a coat of fumed oak stain, glue on the hoops, which are cut from cardboard, and give them a coat of stain. Plug the lower end of the keg with a cork and cut off the bottom at an angle.

Now comes the boat. Find a straight-grained piece of white pine about 2 by 4 by 6 in., mark the shape of the boat on it, and whittle to shape. Next cut the end of the boat in a zig-zag fashion to give it a ragged and broken appearance. Mark the planking with a pencil, and file or cut the grooves. The ribs can be made from wood



In this smoker's set the treasure chest serves as a cigarette box, the wrecked boat is the pipe rack, and the wine cask holds the matches. There's a pirate's bones and cutlass, too!

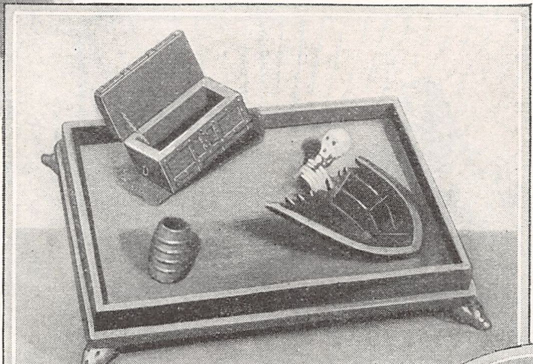
Mr. Alder points out the pirate's ribs pierced by the cutlass; these also appear clearly at the right.

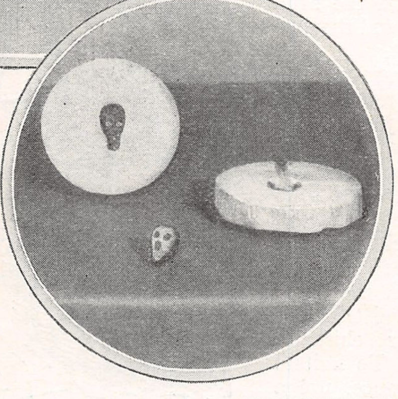
$50 for Novel Ideas

DOESN'T this article suggest to you that many other useful, decorative, story-telling novelties could be designed? If you have an idea for one, write a letter of not more than 250 words about it (with a rough pencil sketch, if you wish) and mail to the Home Workshop, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, on or before April 30, 1931. For the best letter $25 will be paid; for the second best, $10; for the third, $5; and for the next ten letters in order of merit, $1 each.

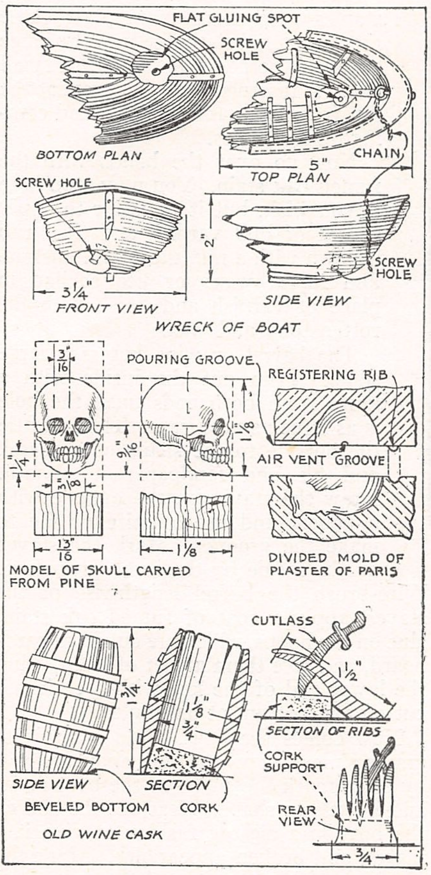
or thick cardboard, but do not put in all of them; remember that you are constructing a wrecked boat, not a new one. Now add the gunwale and attach a small chain in the bow of the boat; it need not be more than 1 in. long. Pins are used to fasten the ribs, keel, gunwale, stem, and chain in place.

The sides of the boat can be painted white first and antiqued later, or the whole boat, inside and out, can be stained and treated in the same manner as the chest.





The complete tray before the sand is added. In the circle is shown the plaster mold for casting the skulls.


FLAT GLUING SPOT
SCREW HOLE
BOTTOM PLAN
CHAIN
5"
TOP PLAN
SCREW HOLE
2"
SCREW HOLE
3¼"
FRONT VIEW
SIDE VIEW
WRECK OF BOAT
3/16"
POURING GROOVE
REGISTERING RIB
1/4"
9/16"
1⅛"
3/8"
AIR VENT GROOVE
13/16"
1⅛"
MODEL OF SKULL CARVED FROM PINE
DIVIDED MOLD OF PLASTER OF PARIS
CUTLASS
1½"
3¼"
1⅛"
¾"
SECTION OF RIBS
CORK SUPPORT
REAR VIEW
¾"
SIDE VIEW
SECTION
BEVELED BOTTOM
CORK
OLD WINE CASK

How to make the wrecked boat, the skull pattern and mold, and the cask, ribs, and cutlass.

The next task is to make the dead pirate's skull and the four skulls which serve as the feet of the tray. When you have whittled the pattern for the skull, make a mold from plaster of Paris as shown. This is done by pouring a mixture of plaster and water into a tin lid, a small cardboard box, or any other convenient container. The skull pattern is well greased and pressed halfway into the plaster, which is allowed to harden. Then a registering groove is cut in the surface of the plaster and the whole surface is oiled or greased. More plaster is now poured in until the skull is completely covered. When the plaster is dry, the two halves of the mold are separated and two grooves are cut into the surface of one of the pieces—a large groove through which lead may be poured and a small one to serve as a vent for the air to escape.

Before the metal is poured, it is most important to allow the plaster to dry through and through, otherwise steam may be generated and the lead spattered about by the force of the explosion. Tie or clamp the halves together, taking care they are exactly in register, and make a cast. If it is satisfactory, cast four more skulls and smooth them up. Paint one a dull white streaked with gray so that it has a dried bone look. Leave the other four the natural lead color or give them a coat of silver or bronze paint, if you prefer. Use black paint for the eyes, nostrils, and jaw markings of all five.

From a piece of cigar box wood, cut out the ribs of the dead pirate. Paint them a dull white and treat them the same as the skull. If you prefer, you can make them from bone, metal, or other material more durable than wood.

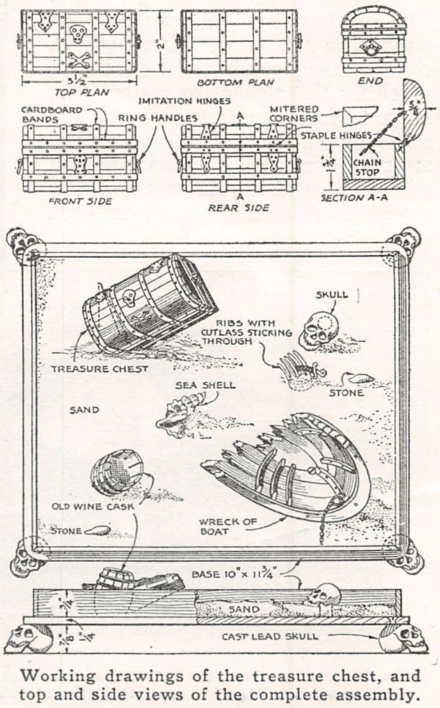
Lead, wood, fiber, or even a toothbrush handle may be used for making the cutlass. Paint it a dull black or a rusty color. To make it stand up between the ribs, stick the point of the cutlass in a cork and glue the cork to the bottom of the tray when you are ready to mount everything.

The tray itself may be any shape you would like to have it. The skull-feet are fastened to the bottom with screws before the rim is added. The tray is wire-brushed and finished to match the chest.

The boat, the chest, the cask, the pirate's bones, and the cutlass are glued and screwed to the bottom of the tray. If the chest does not rest in the sand deep enough, cut one corner off so that it will look to be lower. Cut a wedge to fit between it and the tray, glue the wedge in place, and then glue the chest on top of it.

Be careful to have the boat at such an angle that a pipe will rest in it naturally—that is, so that it will not slide out. The skull should be built up so that it appears to rest on top of the sand. The finishing touch is given by pouring white sand in the tray nearly to the top of the rim.

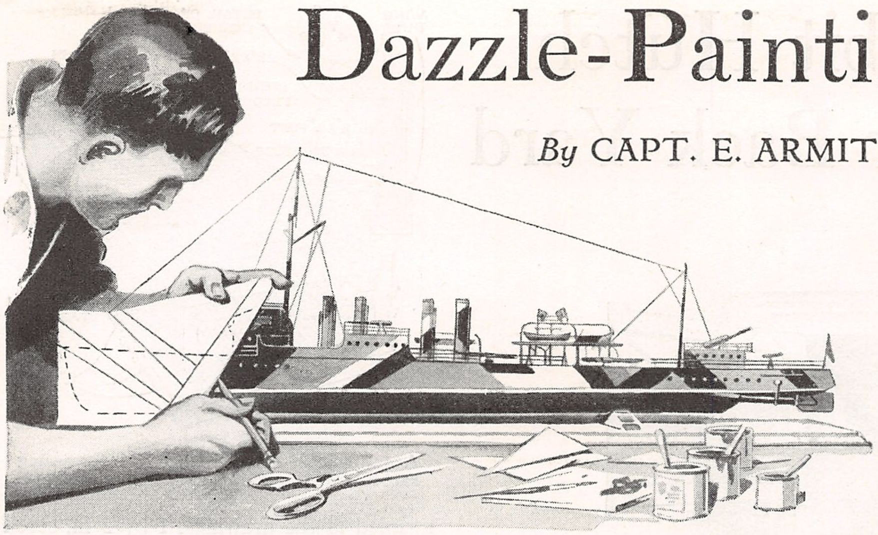
If you like, you can add the charred remains of a camp fire which in reality will serve as a receptacle for ashes.


3½"
2"
TOP PLAN
BOTTOM PLAN
END
IMITATION HINGES
CARDBOARD BANDS
RING HANDLES
A
MITERED CORNERS
5/8"
STAPLE HINGES
1¼"
CHAIN STOP
FRONT SIDE
A
REAR SIDE
SECTION A-A
SKULL
RIBS WITH CUTLASS STICKING THROUGH
TREASURE CHEST
SEA SHELL
STONE
SAND
OLD WINE CASK
WRECK OF BOAT
STONE
BASE 10" x 11¾"
¾"
SAND
7/8"
¼"
CAST LEAD SKULL

Working drawings of the treasure chest, and top and side views of the complete assembly.

Dazzle-Painting a Model

By CAPT. E. ARMITAGE McCANN



How to apply warlike camouflage to the destroyer *Preston*, as if on active convoy duty, instead of giving her the dull, monotonous gray used by the Navy for all ordinary purposes

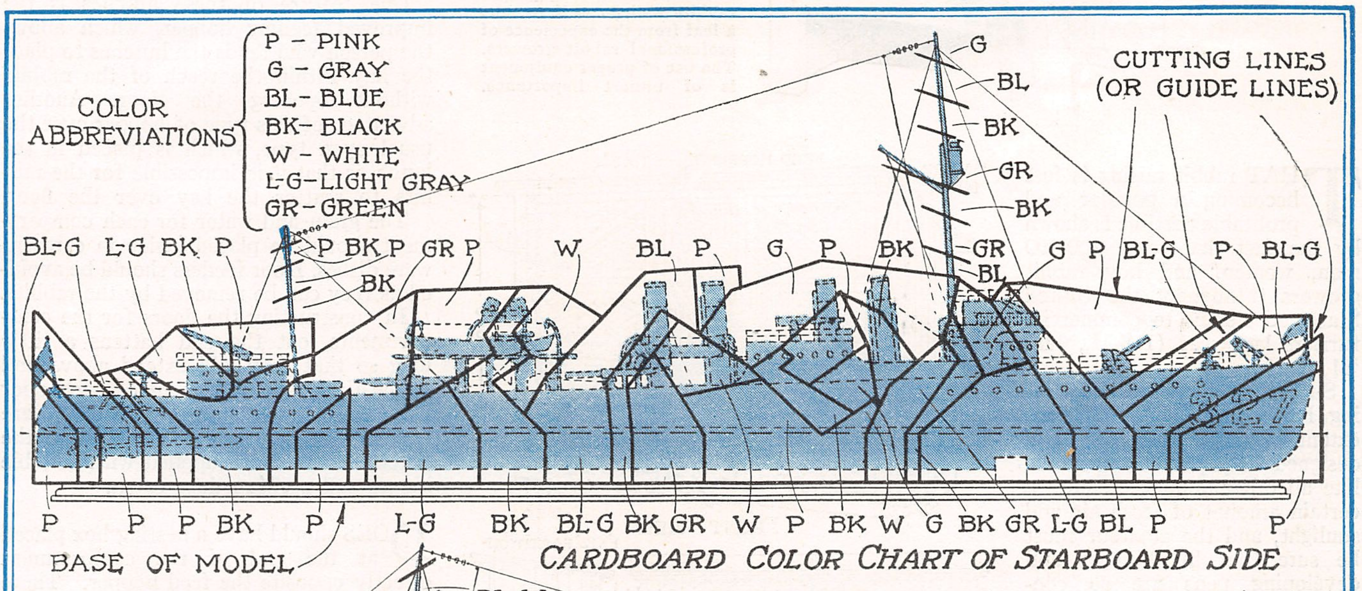
SOME of those who are building our latest ship model, the United States destroyer *Preston* (P.S.M., Dec. '30, p. 87; Jan. '31, p. 90; Feb. '31, p. 90; and Mar. '31, p. 118), may feel that the uniform gray color is rather dull and somewhat out of place in a modern brightly colored room. Possibly other readers have been deterred from constructing the model for the same reason. If so, the remedy is a simple one—camouflage the model as if on active convoy duty in the World War. You will lose the clean, racy silhouette, but you will attain a brighter and more novel effect.

The camouflage used for ships was called dazzle paint. This was intended not to hide the vessel but to make it difficult to distinguish its form and direction of motion. It was used only in independent or convoy work, not in fleet action.

The two accompanying diagrams show the *Preston* model with dazzle painting schemes actually used in the World War. Note that the two sides are different.

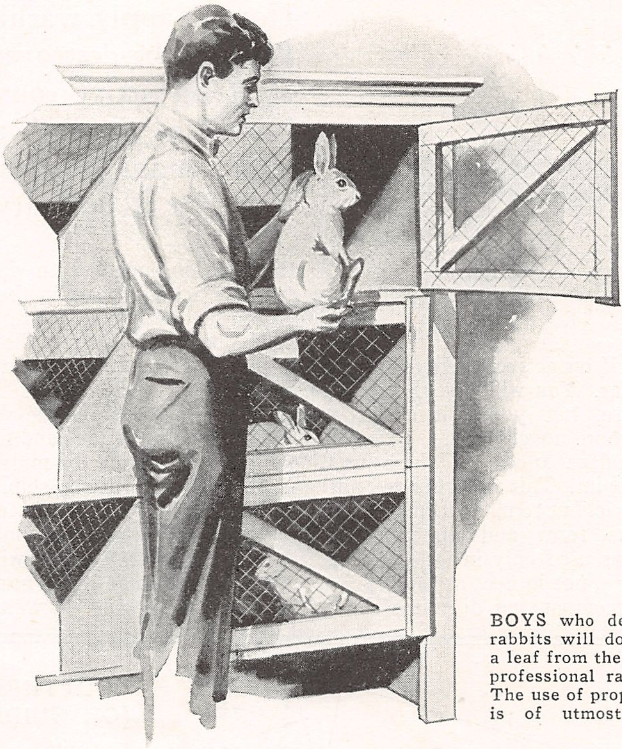
The best way to apply the color scheme is to prepare a full size cardboard guide or chart for each side as shown. Paint all you can see from the water line up, including all structures and fittings. Carry the colors as far as the midship line; that is, to the center of the ship.

The colors, with the exception of the black, should be clear but not very strong. Artists' oil colors thinned with turpentine are excellent. The ship's number on both sides of the bow is left white.

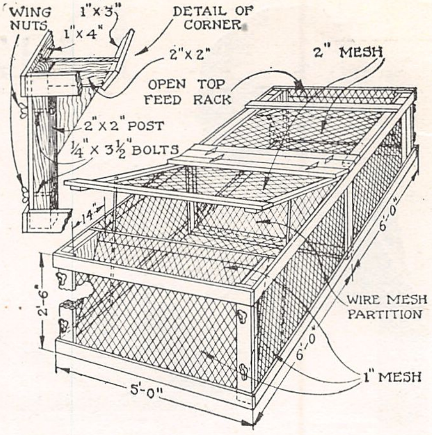

COLOR ABBREVIATIONS
P - PINK
G - GRAY
BL - BLUE
BK - BLACK
W - WHITE
L-G - LIGHT GRAY
GR - GREEN
CUTTING LINES (OR GUIDE LINES)
G
BL
BK
GR
BK
BL-G L-G BK P P BK P GR P W BL P G P BK GR G P BL-G P BL-G
BK
BL
P P P BK P L-G BK BL-G BK GR W P BK W G BK GR L-G BL P P
BASE OF MODEL
CARDBOARD COLOR CHART OF STARBOARD SIDE
COLOR CHARTS, AS SHOWN, SHOULD BE MADE THE SAME LENGTH AS MODEL. COPY THE CUTTING LINES APPROXIMATELY AS SHOWN
BL-W
BK
BL-W
BK
BL-W BK BL LG P GR BK W
GR
BK
CUTTING LINES
BL-W BK P BK BK BL-W P BK BL BL-W BK P
BASE OF MODEL
CARDBOARD COLOR CHART OF PORT SIDE

The cardboard camouflaging guides or templates. Begin painting at one end and cut off the cardboard section by section as the work progresses. Carry the colors only to the water line; below that the hull is dull red.

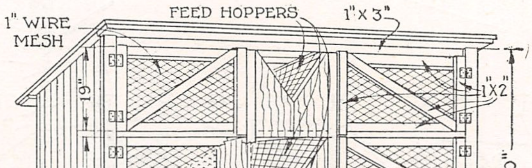
Modern Rabbit Hutch for Your Back Yard



BOYS who desire to raise rabbits will do well to take a leaf from the experience of professional rabbit growers. The use of proper equipment is of utmost importance.



A two-compartment rearing pen for young rabbits. Notice the feed hoppers at each end.



Perspective; rear, end, and plan views; and details of the hutch designed by W. E. Lloyd, an authority on rabbits.

THAT rabbit raising is fast becoming a popular and profitable pastime is shown by the fact that some 200,000 men, women, and boy rabbit growers throughout the United States sold skins to commercial furriers last year (P.S.M., Jan. '31, p. 23).

Success in breeding and raising, however, depends to a large extent on the use of properly designed equipment. Rabbits, like all other animals, require a certain amount of fresh air and sunlight, and the amateur must be sure that his hutches and developing pens are so constructed as to provide these important essentials.

The hutch and developing or rearing pen illustrated in the accompanying drawings are the result of many years of experience and research on the part of W. E. Lloyd of the College of Agriculture, University of California. These designs represent the latest and most efficient developments in rabbit raising equipment.

The 3-tier, 6-compartment hutch shown directly at the right is constructed almost entirely of 1-in. lumber and 1-in. mesh wire netting. For the netting, galvanized wire mesh should be used in preference to the welded type, as it is cheaper, often easier to obtain, and far more durable for this purpose. In order to prevent the rabbits from gnawing the wood, the netting is placed on the inside of the doors.

While 2 by 2 in. floor joists are recommended in the drawings, 1 by 2 in. stock has been found to be sufficiently strong. Indeed, all of the lumber required can be obtained from old packing cases.

At the rear of each tier is a 1½ by 8 by 19 in. galvanized iron waste pan, which is placed under an opening in the floor. This opening extends into each of the two compartments on each tier. The partition forming the division over the pan should stop just above the wire netting which is placed over the opening to prevent small rabbits from becoming caught.

One feature of these hutches is the improved feeding hopper, which allows the person who tends the hutches to place the hay within the reach of the rabbits without opening the door. Another advantage of this type of hopper over the usual open type, which is placed in the hutch, is that it is impossible for the rabbits to scatter the hay over the floor.

The grain and water for each compartment should be placed inside in earthenware dishes. Door feeders should be avoided as they can be removed by the rabbits.

In constructing the doors for the compartments, cut the end battens a little long so that they will extend above and below the top and bottom of each door to serve as door stops. The doors are preferably set flush with the sides of the hutch, and each is supplied with suitable hinges and a cheap door catch.

DOES should have a nesting box placed at the end of the compartment directly opposite the feed hopper. These nests should be about 10½ in. high, 11½ in. wide, and 18 in. long (inside dimensions). An ordinary apple box can be altered easily to serve.

Some nests are built with a partition in the middle, and have the entrance at the opposite end from the actual nesting compartment. This will prevent the doe from scattering the young when she enters.

Rearing or developing pens similar to that shown are needed for the young rabbits. As in the hutch, 1-in. lumber is used almost entirely in the construction. The sides of the pen, together with the feed hoppers, are covered with 1-in. wire netting, while the top and bottom are covered with 2-in. netting. This type of pen will allow young rabbits to feed on green grass without the danger of having them dig their way out. Such a pen, built to the dimensions suggested, will accommodate from eight to twelve rabbits in each compartment.

Keeping *Golf Clubs* in Repair

Alex J. Morrison, *noted authority on golf technique, tells how to look after your irons and woods*

EVERY golfer takes great pride in his clubs. He is one workman—if I may call him that—who believes in the fitness of his tools as a deciding factor in his success.

By his very nature he is, alas, forever looking for something on which to blame the failure of his shots to reach the intended mark. Even a small gap in the leather of the grip on his club or a loose binding string prove to be a great annoyance. This is why everything about a golfer's kit should be shipshape.

After he has once become acquainted with each of his clubs, they seem to develop into a living part of the player himself. I know many a player who has become so attached to a favorite set of clubs that he would rather part with his right arm, figuratively speaking, than to lose them. You probably feel this way yourself. And if you do, you must realize how necessary it is to keep your clubs in the best of repair. Just get them out and look them over. Many of the simpler repairs you can make yourself; indeed, you can do it in less time and, of course, at much lower cost than if you searched out a professional club maker.

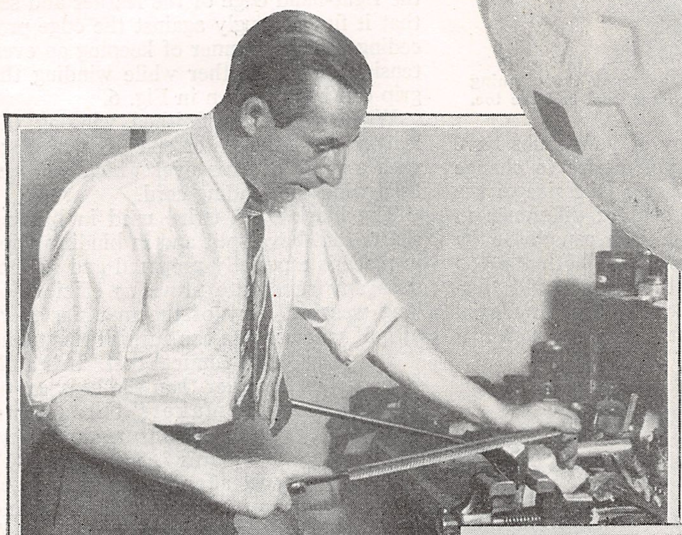


Fig. 1. Wooden clubs can be refaced easily with a file. The loft also may be altered to suit, if so desired.

To begin with, take up your wooden clubs. What shape are they in? Have they been properly protected from moisture?

Clubs that have been out in the rain or that have been dragged through wet grass always should be wiped dry with an oily rag after use. Under no circumstances should clubs be put away without first drying them thoroughly. Moisture, if left on the head of a wooden club, will not only ruin the finish but will cause the parts to loosen up generally, thus spoiling the club.

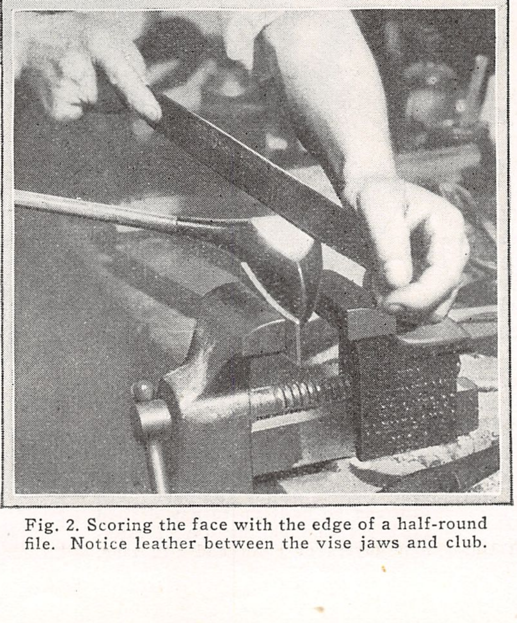


Fig. 2. Scoring the face with the edge of a half-round file. Notice leather between the vise jaws and club.

Moisture tends to open up the grain of the wood, and when the wood dries, particularly in the case of wooden clubs with fancy inserts of other materials, the hitting surface begins to warp and crack. A common mistake that players often make is to put a dried-out club into water in the hope that it will tighten up the screws and other fittings that may be loose.

Keep the wooden clubs out of water at all times. When you are through using them for the season, put a few drops of linseed oil on a rag and wipe them thoroughly. Then take another rag with a mixture of a few drops of oil and a little shellac and give the club a vigorous rubbing. This will coat the surface and make it impervious, for a time at least, to further moisture.

If any of the inserts, such as ivory or fiber, have become loosened, it will be best to turn the club over to an experienced club maker or to return it to the factory where it was made. It is part of the service that manufacturers

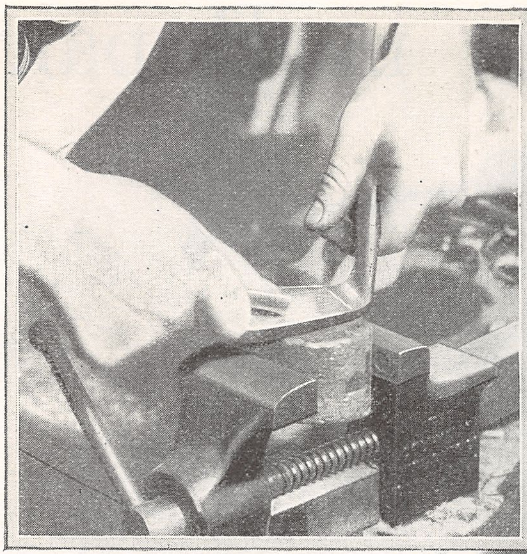


Fig. 3. Fine emery cloth is used for polishing the heads of iron clubs. Support the head on a steady surface.

render to their patrons to recondition patented inserts, which in many cases are guaranteed not to loosen up.

If the surface of the club head has become scarred, remove the old finish with an ordinary cabinet scraper or a piece of glass and then smooth the head with fine sandpaper. For refinishing, the darker colors seem to be most popular and serviceable for wooden clubs. The choice of color, however, is a matter of personal preference; the important thing is to see that you apply the stain with a rubbing motion that will distribute it evenly and in a very thin coating. The luster and finish can later be obtained by rubbing the surface with a rag on which a few drops of linseed oil and a very small amount of shellac have been placed.

If you desire, you can put a new surface on the face of your wooden clubs or change the loft you now have on your driver, brassie, or spoon by placing the head of the club in a vise as shown in Fig. 1 and filing the striking surface of the club face to the desired angle. The lines running across the surface, which help the club face to grip the ball, can be applied by using the edge of a half-round file in the manner shown in Fig. 2. Whenever the head of a wood club is placed in a vise, pad the jaws with leather.

Iron clubs, particularly when they are steel shafted, require little care other than a periodic cleaning and a frequent inspection of the condition of the leather grip and cord bindings.

In the event that the head on a wooden-shafted iron becomes loose, it must be removed from the shaft and reset after the shaft has been wound with sufficient twine to insure a tight fit. Such work as this should be done only by an experienced club maker.

To clean iron clubs of the type that are not made of a rustproof metal, use medium fine emery cloth. Take a piece about 3 in. square and first clean the neck of the club head by twirling the club around in the cloth, which is held in the palm of the hand. The remaining portions of the club head can be polished in the manner illustrated in Fig. 3.

If you care to put a finishing touch to your cleaning, you can polish crosswise on the heel and toe of the club face, thus adding greatly to the appearance of the job (see Fig. 4). Of course, if you are fortunate enough to have a buffing wheel, you can save considerable time in doing this work. Immediately after cleaning your iron clubs, the heads should be covered with a thin coating of light machine oil or petrolatum (sold commercially as vaseline).

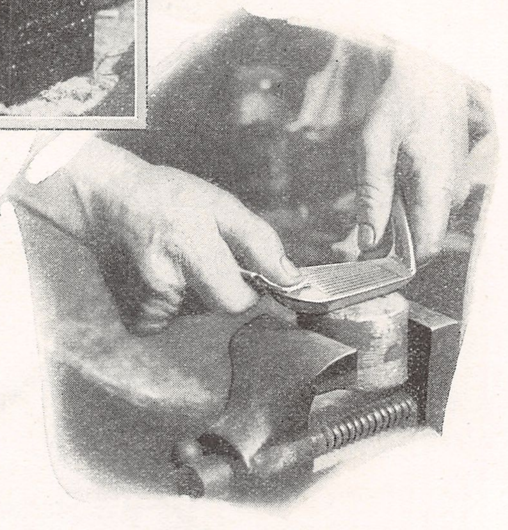


Fig. 4. A finishing touch can be given the cleaning by polishing crosswise on both the heel and the toe.

If the grips on any of your clubs have become loose or if you desire to change the thickness of any grip (the size of the grip makes a great deal of difference in the feel of the club), you can do so by first removing the string at both the top and the bottom of the leather and then unwinding the leather. The material under the leather may also be rough and uneven; if so, it is best to remove a layer or two until the surface is absolutely smooth.

In building up the grip to the desired thickness, wrap a number of 1 in. wide strips of shirting around the shaft, spiraling downwards from the top (see Fig. 5). The material used in building up the grip, as well as the leather itself, must have a sticky surface to hold it in place after it has been wrapped, and the best way to obtain such a surface is through the use of a good grade of tire tape. Wrap a layer of the tape and a layer of the cloth and then some more tape. As a rule, the shaft is large enough to require only one or two extra layers of material under the leather in order to give the grip the needed thickness. Just try the leather over the tape and cloth to see if you have built up the grip sufficiently.

After you have shaped the base material, leaving a top surface of cloth to which you can add library paste or shellac to help hold the leather in place, take the leather as it came off the club and fasten it to the wooden plug at the upper end of the shaft with a small tack driven into the wood. The manner in which you wind the leather on the shaft determines what kind of a grip you will have when the job is finished, so it is best to take pains to get the leather wound tightly from the very start.

As you wind the first lap, be sure that the edges of the strip overlap; then, as you spiral down the shaft, keep track of the right-hand edge of the leather and see that it fits in snugly against the edge preceding it. The manner of keeping an even tension on the leather while winding the grip can best be seen in Fig. 6.

When you have finished winding the leather, hold the lower end of it in place with a piece of tape over which you can then wind the binding cord.

The black linen twine used in binding shafts that have split and in binding grips in place is especially prepared and seldom does any substitute prove as efficient or long wearing. Any of the manufacturers of golf merchandise can furnish this twine at a nominal cost. It is a bit heavier than the heaviest of shoemakers' thread and treated to insure durability.

Figures 7, 8, 9, 10, and 11 will afford a better idea of just how to handle the twine in wrapping your clubs. A right-handed person should hold the club in his left hand

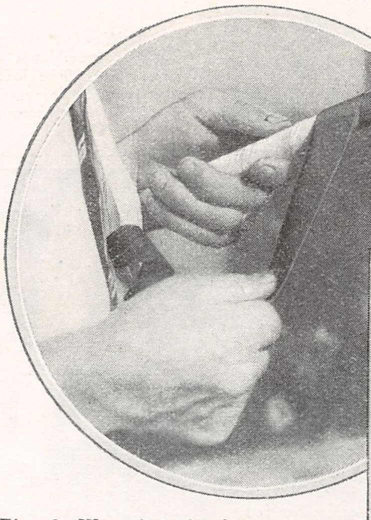


Fig. 6. Wrapping the leather over last layer of cloth. This operation follows that shown at right (Fig. 5).

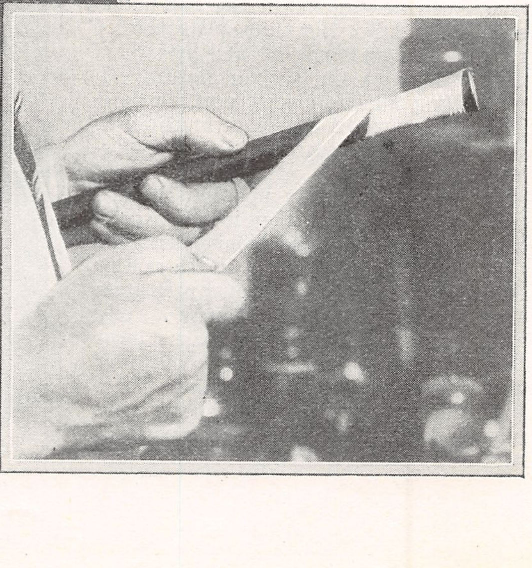
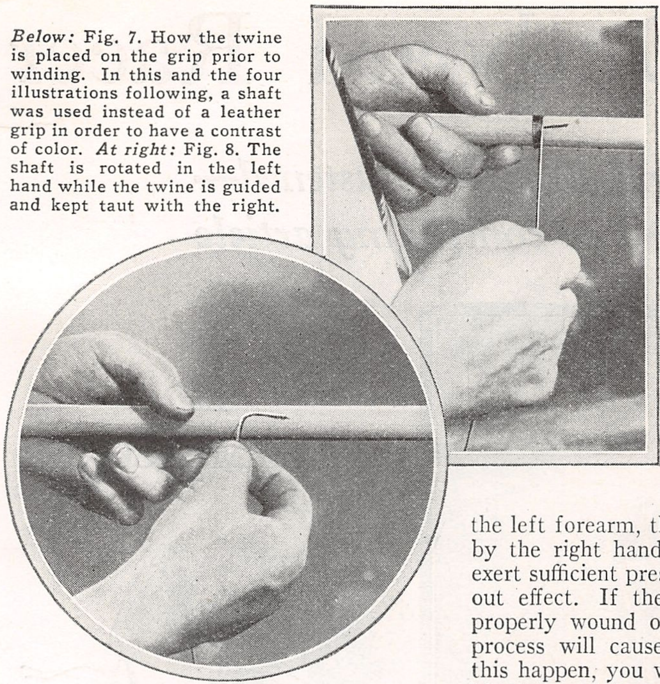
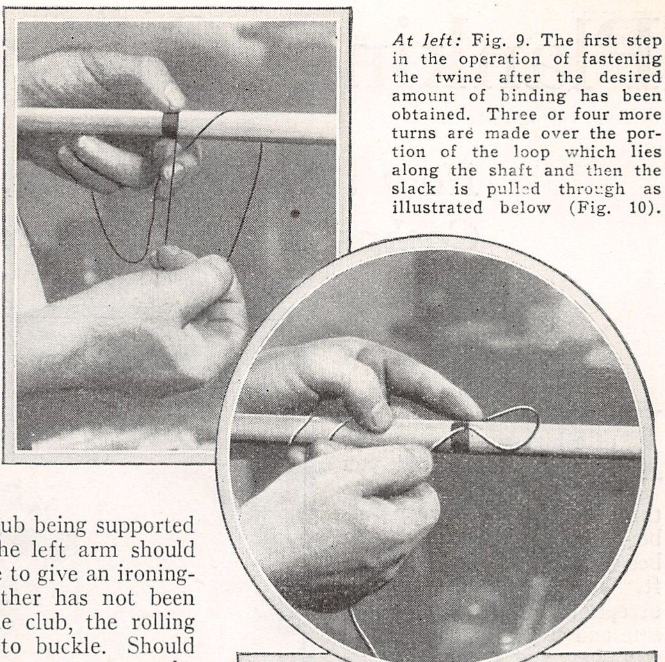


Fig. 5. Wrapping a layer of cloth over a layer of the tire tape. The grip can be built up to any desired thickness through the use of alternate layers of cloth and tire tape.



Below: Fig. 7. How the twine is placed on the grip prior to winding. In this and the four illustrations following, a shaft was used instead of a leather grip in order to have a contrast of color. *At right:* Fig. 8. The shaft is rotated in the left hand while the twine is guided and kept taut with the right.



At left: Fig. 9. The first step in the operation of fastening the twine after the desired amount of binding has been obtained. Three or four more turns are made over the portion of the loop which lies along the shaft and then the slack is pulled through as illustrated below (Fig. 10).

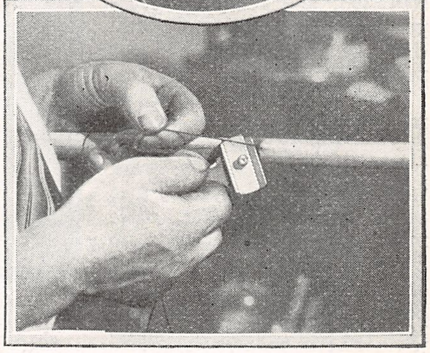


Fig. 11. Cutting the twine off close. All bindings should be given a coat of shellac.

and guide the cord with his right hand. This may sound like an unnecessary point to make, but the correct winding of either leather or twine cannot be done in any other way unless, of course, the original workman who constructed your clubs happened to be left-handed.

In wrapping, the club is continually turned counterclockwise (away from you) with the left hand while the right hand guides the twine and controls the tension with which it is wound. The winding should be started over a bent end of twine as shown in Fig. 7. By following Figs. 7 and 8, you will see that you handle the twine with your right hand placed over the twine. When near the end of the winding, however, place your right hand palm up and to the left of the twine and, taking hold of the twine 8 or 10 in. away from the shaft, invert a loop over the shaft as in Fig. 9. Now take the portion of the loop which is a continuation of the winding and wrap three or four loops over the end of the cord which lies along the shaft. Then pull through the slack as in Fig. 10 and cut it off as in Fig. 11.

As a finishing touch, roll the grip portion of the club on any clean and even surface (see Fig. 12). This rolling is best done on the bench with a 3-in. board held under the left forearm, the club being supported by the right hand. The left arm should exert sufficient pressure to give an ironing-out effect. If the leather has not been properly wound on the club, the rolling process will cause it to buckle. Should this happen, you will have to remove the bindings and the leather and proceed again from the point of tacking the leather to the wooden plug at the top of the shaft.

The last thing to do with the wrapping is to coat the strings with shellac. This will not only help to preserve them, but will give a finished appearance to the job.

In putting your clubs away for any length of time, it is very important to place them in a position where they will lie absolutely flat, say on a shelf—even on the floor would be better than standing them up in a corner (see Fig. 13). Clubs that are left standing, even though protected somewhat with a reënforced bag, are subject to a strain. This may be so slight that it will not be noticed until the bends have progressed beyond repair.

While I have suggested methods of making some of the minor repairs on golf clubs in your own home workshop, I still warn you against undertaking anything that has not been outlined. Leave the more intricate work to the original manufacturer of the clubs. In most cases the clubs have been put together with the aid of machinery and special tools, and it is futile to attempt to do by hand what can be accomplished only by means of the manufacturer's special equipment.

The author wishes to express his appreciation to J. G. Mac Gowan, a New York golf professional, for posing for the photographs used to illustrate this article.

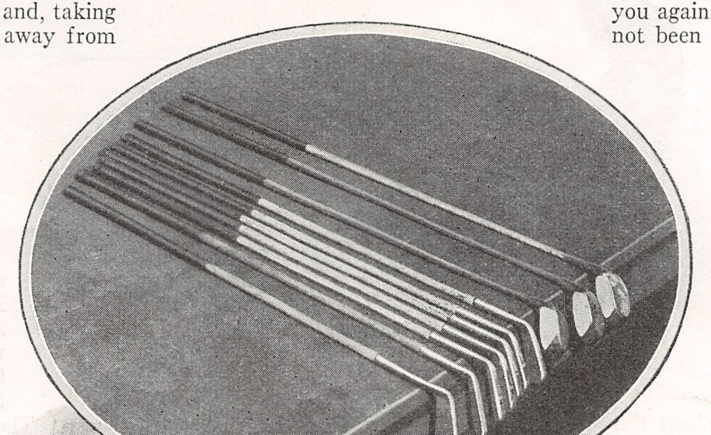


Fig. 13. When clubs are to be put away for the winter, they should be stored lying down on some flat surface.

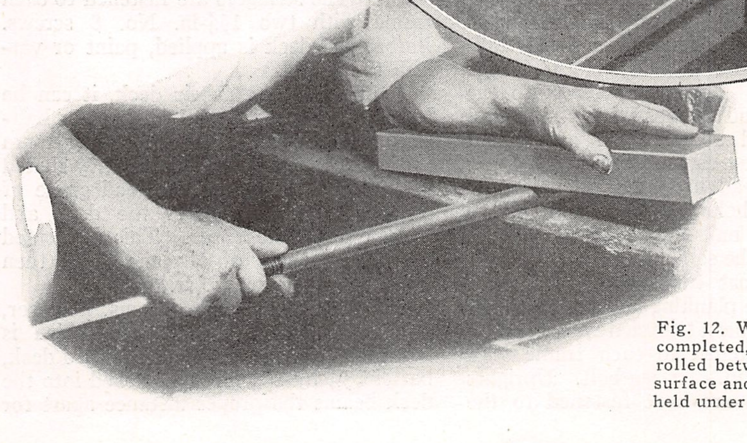


Fig. 12. When the grip is completed, it should be rolled between any smooth surface and a block of wood held under the left forearm.

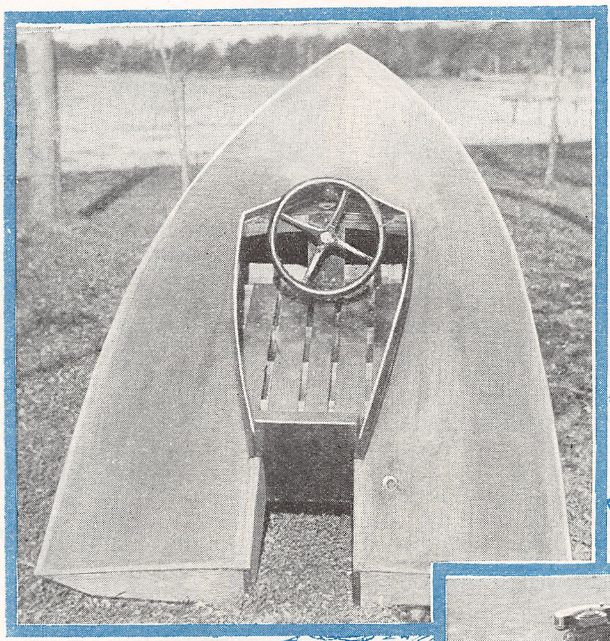
Portable electric heaters are oftentimes used in bathrooms where it is difficult to prevent water from being splashed on them and discoloring their highly polished copper bowls. To clean them, remove the guard, rub the reflector with a rag soaked in ordinary household ammonia, and shine the bowl with a good metal polish. This will restore the brilliancy to any high-grade copper reflector, but it will not work on reflectors which are merely sheet iron which has been copperplated.—Frank Frost.

Planking Our Outboard Racer

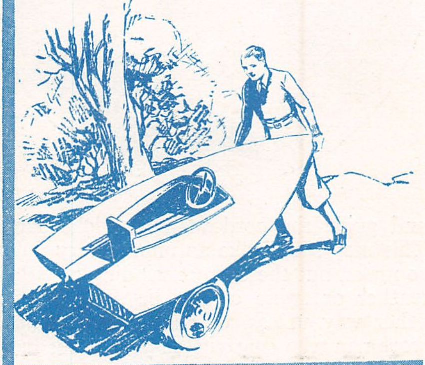
How the sides, bottom, and deck are fastened—Cockpit and floor boards—The concluding article

By

WILLIAM JACKSON



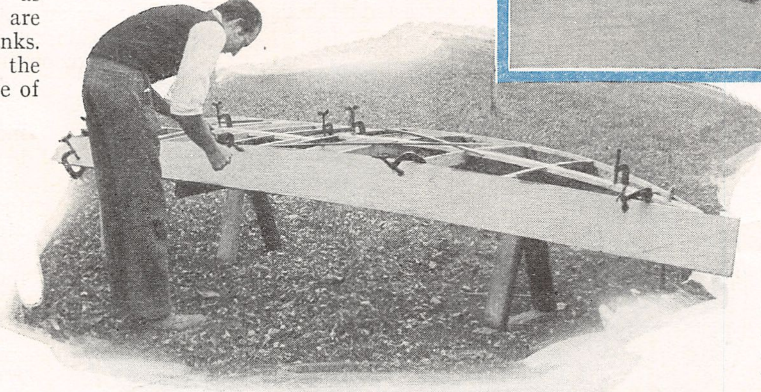
An excellent view of the completed outboard racer showing the motor board, well boards, and tailboards. Notice the steering gear and floor boards.



If you enjoy speed, outboard racing will give you all of the thrills that you desire.

IF THE throb and the roar of a high-speed motorboat stir your blood and you long to experience the thrill of driving your own outboard racer, you cannot do better than to build the 11½-ft. boat illustrated. It is exceptionally speedy, quite safe and stable, simple in construction, and relatively inexpensive. The original hull cost the writer only $25 for materials.

Some of those who read last month's article on the framing of the hull (P.S.M., Mar. '31, p.92) probably have the work well under way by this time; others who missed that article may begin now by looking up a copy of the March issue or by sending for POPULAR SCIENCE MONTHLY Blueprints Nos. 128 and 129, which contain the complete working drawings and a list of the materials required (see page 117).



Large C-clamps are used to hold the planks in position until the fastening screws are driven in.

After the framework has been completed as far as described last month, you are ready to attach the side planks. First, coat the chine, the inwale, and the outside edge of the tailboard with glue. Apply strips of cloth along the glued sections, and clamp the plank to the side. Screw the plank with every care to each frame with 1-in. No. 6 screws, spaced about 2 in. apart. Use a double row of screws on the tailboard. For the time being use two screws between frames to fasten plank to chine. When the step is cut out and the edge along the chine is trimmed, complete the fastening of the plank to the chine with 1-in. No. 6 screws, spaced about 2 in. apart. Use 1-in. copper nails about 3 in. apart to fasten the plank to the inwale.

With both sides on, the boat is ready for the bottom planking. The afterstep section is planked first. When removing the clamps from the keel, make sure the bottom does not change shape. Cut the bottom planks 7⅝ in. wide.

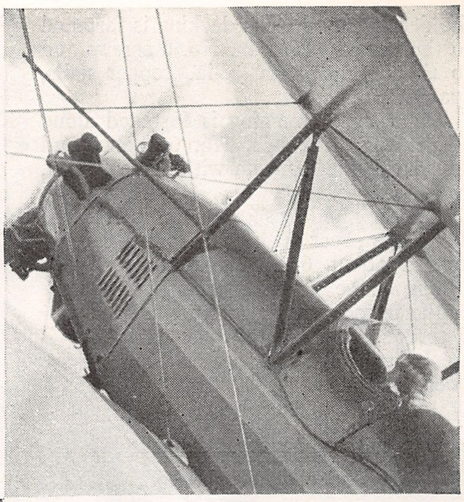
Place a plank on the center line of the keel, and mark the frames at the outside edge of the plank. Cut notches for the batten strip in the center of this mark, so that the seams between the planks will meet in the center of the batten. Notch the battens halfway into the tailboard. Fasten battens to frames with small nails. Coat the keel, batten, and well and tailboards with glue and lay cloth on the glued surface. Fasten the plank to the keel, chines, and frames with 1-in. No. 6 screws, spaced about 2 in. apart, and nail it along the batten with 1-in. copper nails. Drill lead holes for all nails and screws, and hold an iron underneath to clinch the nails. The whole bottom is fastened in the same manner.

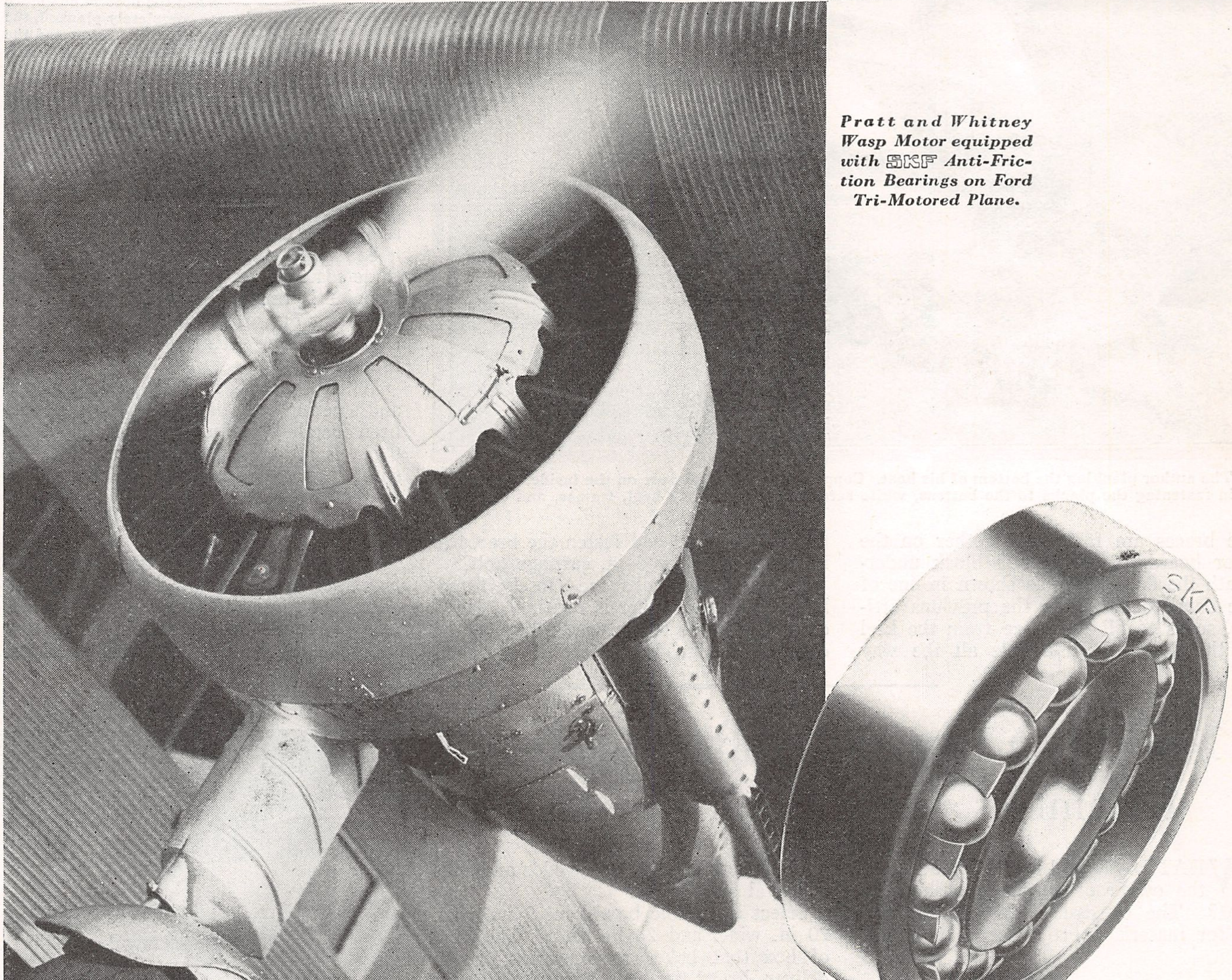
With the boat turned over and after the edge of the planking along the inwales and chines has been trimmed even, the deck beams are fastened to each frame with one ¼ by 1¾ in. carriage bolt. Uprights ¾ by 1½ in. are next fastened to the cockpit frames and to frame No. 5 with two 1¾-in. No. 8 screws. The cockpit railing, which is ⅜ by 1½ in., is fastened to the transom and deck beams with one 1¾-in. No. 8 screw. The stringers are fastened to each frame with two 1¾-in. No. 8 screws. Before the deck is applied, paint or varnish the inside.

If one wishes a fabric deck, it can be had by notching ⅜ by 1 in. battens halfway into the deck beams, letting them project ½ in. above the deck; they should be spaced 6 in. apart. A good grade of muslin is stretched over the deck and tacked along the sheer. This is treated with three coats of airplane dope, then painted any desired color.

The boat in the illustrations, however, was built with a wood deck, which is heavier but stronger. For the wood deck, battens ¼ by 1¼ in. are notched into the deck beams the proper distance apart for

WHEN A BEARING FLIES... THERE'S NOTHING BUT PERFORMANCE THAT COUNTS!





Pratt and Whitney Wasp Motor equipped with SKF Anti-Friction Bearings on Ford Tri-Motored Plane.

● *Every aviator knows that "Nothing is apt to cost so much as a bearing that cost so little."*

Along the skyways . . . where chances are always much too long to take . . . where human lives and the development of a new industry depend upon Performance . . . the bearings invariably are SKF.

Men who plan and build the things that fly do not buy on price. Price alone *means* nothing up where wing-tips brush cloud-tips in passing. Performance is the only thing that counts.

And so today there are more SKF Anti-Friction Bearings in use on aircraft and aircraft equipment than all other makes of bearings combined. **SKF** Industries, Inc., 40 East 34th St., New York, N. Y.

SKF

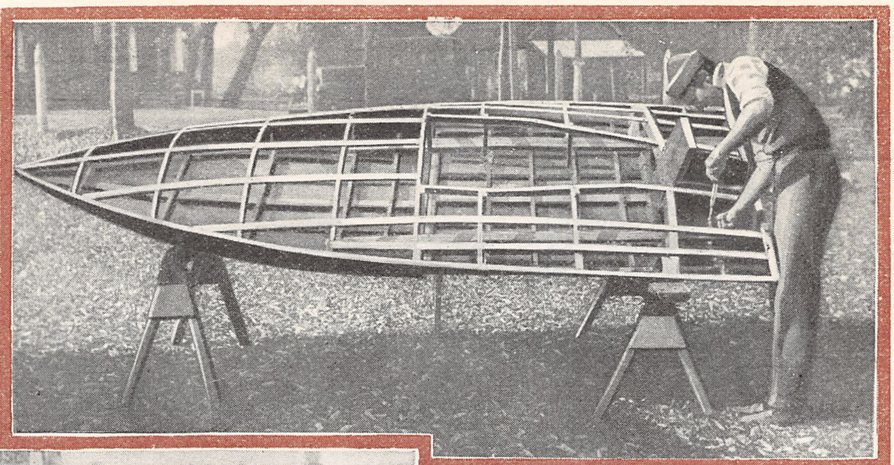
Ball and Roller Bearings

2654

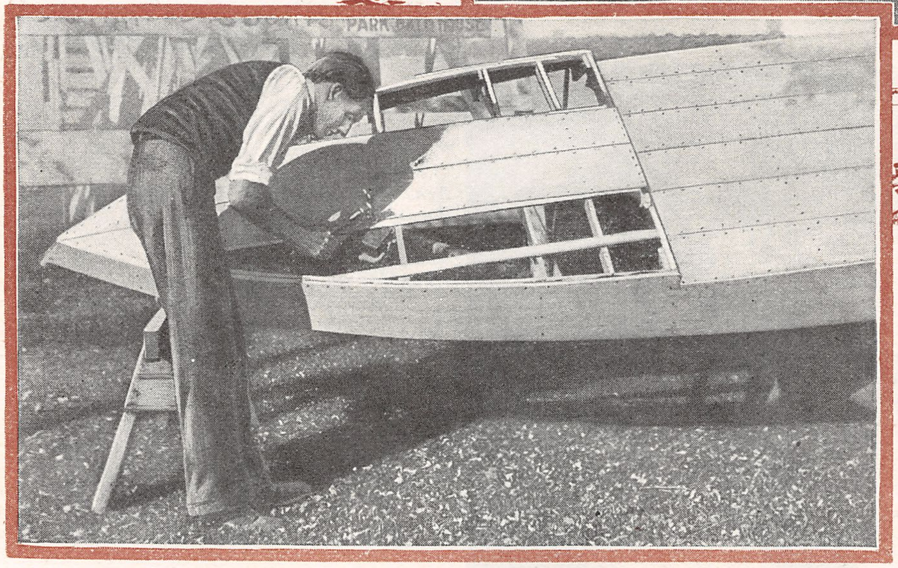
the decking used. The decking is fastened to the beams with 1-in. No. 6 screws and to the battens with ¾-in. copper nails, spaced 3 in. apart.

The cockpit coaming is fastened along the railing with 1-in. No. 6 screws and secured to the transom with three 1¾-in. No. 8 screws.

A sheer molding ⅜ by 1 in. is fastened along the sheer with 1-in. No. 6 screws, spaced about 6 in. apart.



When the bottom and sides are completely planked, the boat is turned over and the top decking put in place.



The author planking the bottom of his boat. Copper nails, clinched over on the inside, are used in fastening the planks to the battens, while screws are used along keel, frames, and chines.

Screw the floor boards to the frames with 1-in. No. 6 screws. Bolt the tubular steel braces to the motor board with two ¼ by 2¼ in. carriage bolts. Where the braces are fastened together on the floor board, place a wood block underneath the floor board as shown in one of the detail drawings in the previous article, so as to fill the space from the keel to the floor. Drill a hole all the way through the keel and fasten the braces to it with one ¼ by 3 in. carriage bolt.

If the hull planks are closely fitted, little or no seam filler is required. However, any seams which need filling can be closed with a good commercial seam composition or calking cement. About ½ lb. is all that will be needed at the most. In the absence of a commercial composition, mix equal parts of linseed oil and whiting putty and paste white lead; this makes a fair seam filler.

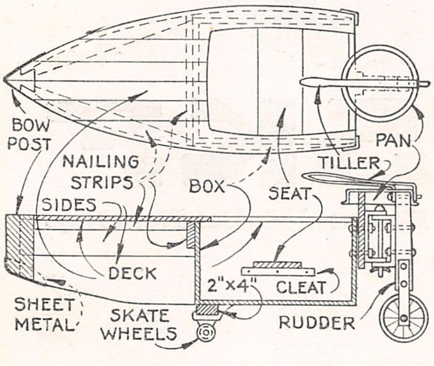
Sandpaper the hull smooth and apply three coats of spar varnish or paint. Even if paint is used, it is well to apply two thin coats of varnish first in order to give the succeeding coats of paint a good foundation.

When the hull is completely finished and steering gear of the desired type has been installed, a fin, approximately 5 by 9 in., is attached 1 in. aft the step. Be careful to secure this fin exactly in the center of the hull. The fin may be purchased from any marine supply company.

Any specific questions in regard to the construction of this boat should be addressed to Mr. Jackson in care of this magazine. Be brief and definite and inclose a stamped, self-addressed envelope.

Novel Toy Pushmobile Boat for Boys Resembles an Outboard Speedster

WHAT boy would not be proud to be the owner of a speedy pushmobile boat? The construction is simple, and as for materials, little else than a few scraps of lumber and a few odds and ends of metal are needed.

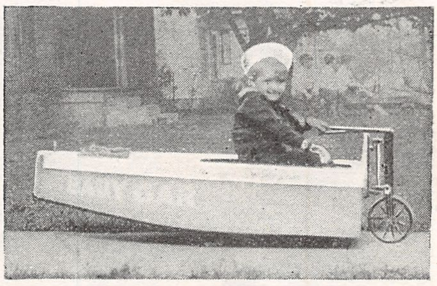


Drawings showing the construction. Notice that a pan is placed on top of the "rudder" to give the appearance of a motor flywheel.

Select a suitable box about 9 in. deep, 20 in. wide, and 28 in. long. The kind of box that bakeries sometimes use to deliver bread in will serve admirably since the sides are strong and the ends are reënforced with wire and staples.

Next, cut a 10 in. long three-cornered block for the bow post. To this fasten the strips for the sides, bringing them back along the sides of the box and fastening them in place with nails or screws. Additional strips are used to form the deck. If sufficient lumber is not at hand, canvas stretched on a wood frame may be used.

The two parts from an old roller skate are then fastened to each end of a piece of 2 by 4 in. lumber. The length of this piece is determined by the width of the box. This is fastened on the bottom, midway between bow and stern.

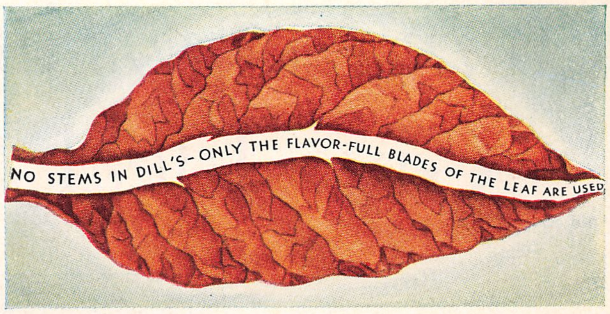


Made from odds and ends, this toy boat will afford small children many hours of safe fun.

In making the "rudder" assembly, take a piece of hardwood 1½ in. square and to one end bolt two pieces of ¼ by 1 in. strap iron to form a fork for the wheel. Fasten the rudderpost to the stern with a hinge made from strap iron or with two sturdy door hinges. An arm made of wood or strap iron is fastened to the top of the "rudderpost" to serve as a "tiller." A tin pan placed on top of the "rudder" will make it look more like a motor.

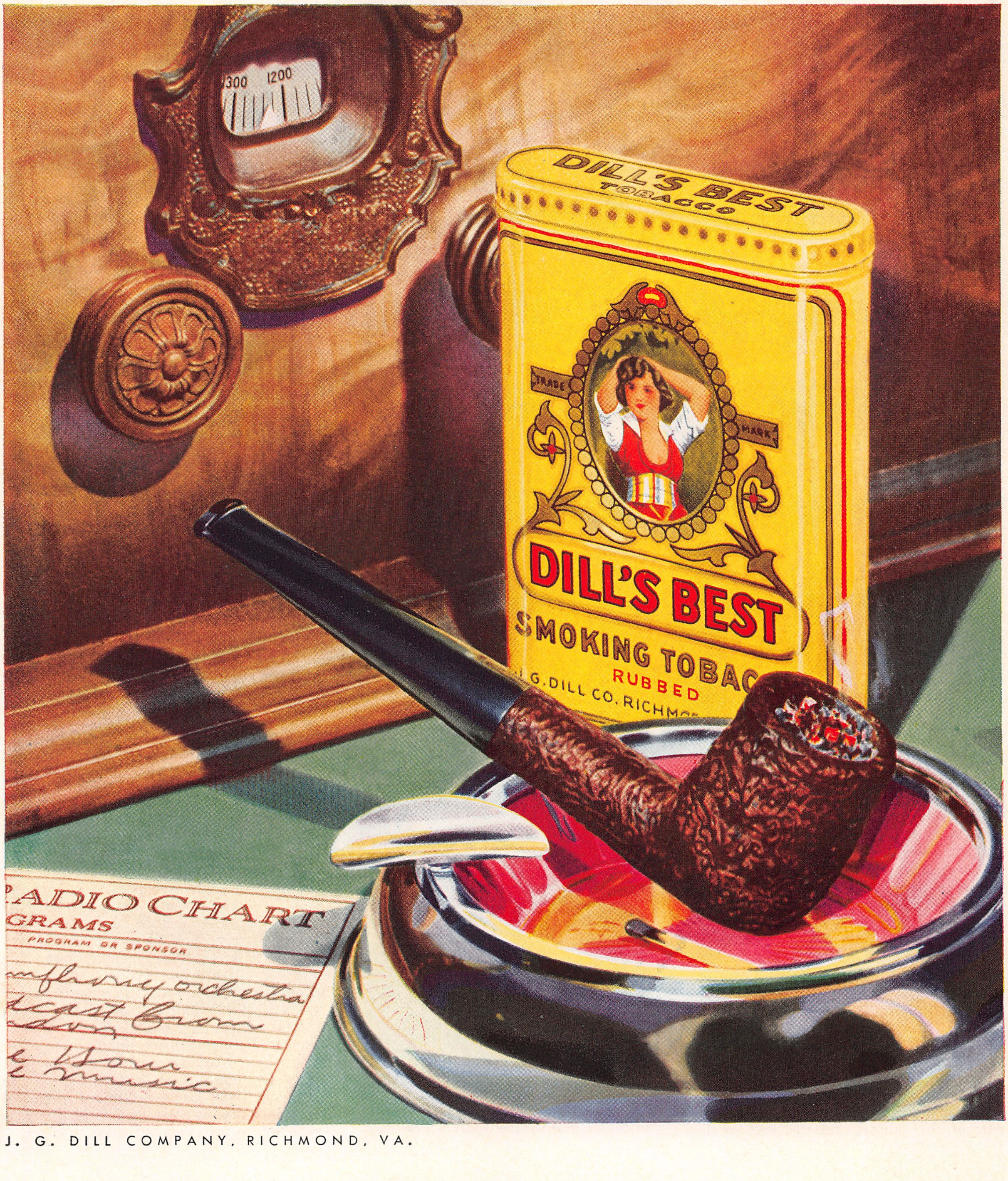
Paint the pushmobile boat in imitation of the real thing and add an appropriate name or number.—CHARLES M. RICE.

Clear and mellow your pipe brings in the message . . . .


NO STEMS IN DILL'S – ONLY THE FLAVOR-FULL BLADES OF THE LEAF ARE USED

SINCE 1848

Dill's Best is America's Best


300 1200
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mphony orchestra
dcast from
e Hour
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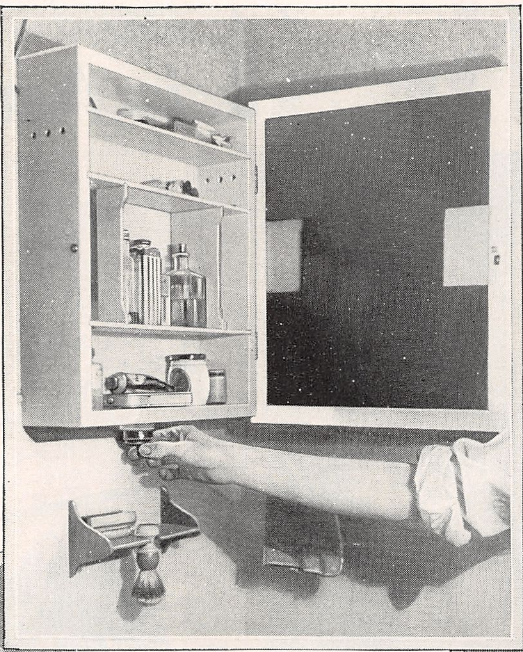
J. G. DILL COMPANY, RICHMOND, VA.

Twin Lamps in Medicine Cabinet Give Ideal *Shaving Light*

By

WALTER E. BURTON

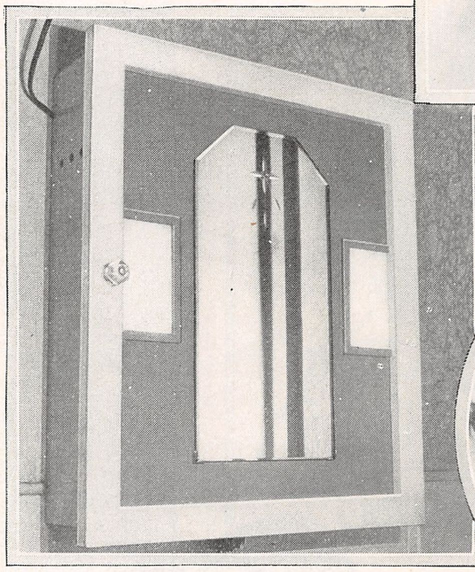
LIGHT coming through opal-glass windows from two lamps placed in compartments inside this medicine cabinet makes shaving almost a pleasure.



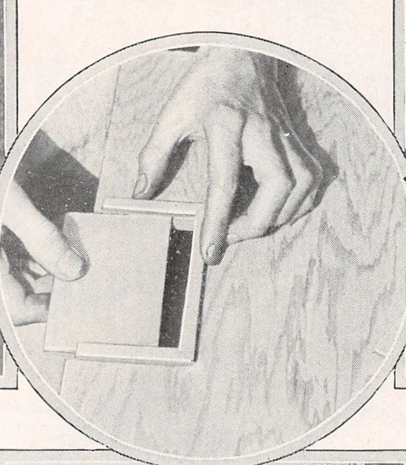
The cabinet with the door open, showing the switch at the bottom and the opal-glass windows.

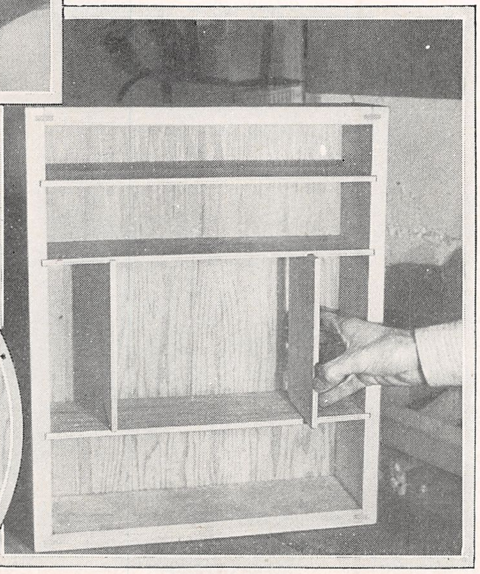
You can construct the cabinet of almost any kind of wood from ½ to ¾ in. thick. The corner joints may be glued and nailed or made in any way desired. Rabbet the rear edges of the sidepieces to a depth of about 7/16 in. to receive the ¼-in. plywood back, and fasten the back securely, for it must support the weight of the cabinet.

Dimensions are governed largely by your personal needs or tastes. A satisfactory size, measured inside, is 4 by 14 by 18 in. The two compartments for the lights, which are tubular show case lamps of 25-watt size or larger held in porcelain sockets, should be not less than 7 in. long, 2½ in. wide, and 2½ in. deep. The partitions can be plywood or other thin material. Semicylindrical reflectors can be bent as shown from polished aluminum cut from a ten-cent pan.

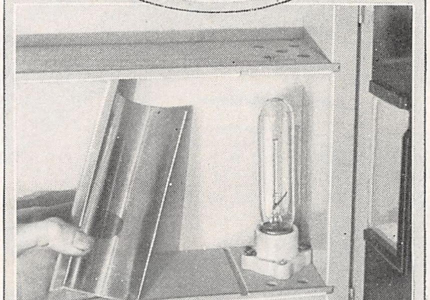


From the windows at each side of the mirror a diffused light falls on the shaver's face.





The arrangement of the shelving and the partitions for the two 25-watt show case lamps.



One of the lamps and its aluminum reflector. *In circle:* How window is set in door panel.

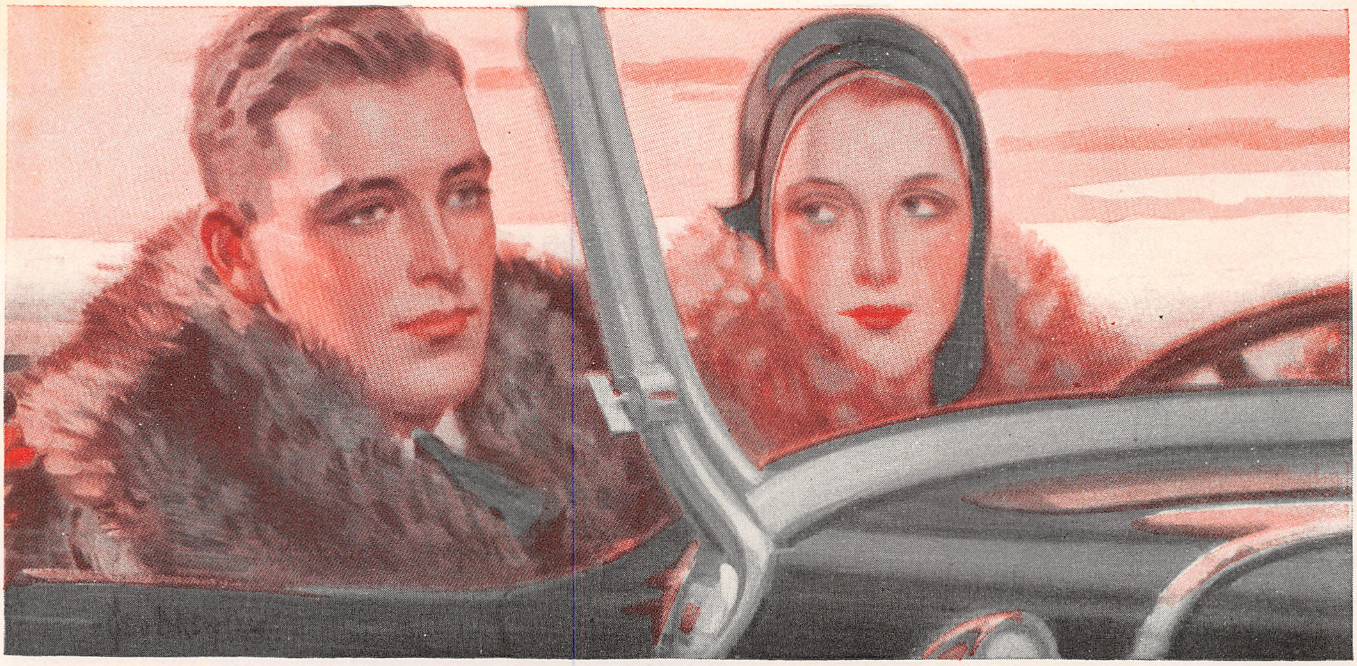
The shelving arrangement will, of course, have to conform to the inside space not occupied by the lamp compartments. Either glass or plywood shelves may be used.

In rabbeting the sidepieces to receive the back, you are to make the cut about 3/16 in. deeper than required for the back alone, if you follow the specifications just given. This creates a space between the rear of the cabinet and the wall so that the flexible fixture wires may be concealed. Wire the lamps in parallel in the usual manner, and place them in series with a toggle switch (various types can be obtained). The switch handle should be on the outside of the cabinet, either at the bottom or on one side. It is advisable to bore several ¼-in. holes in the bottom, shelves, and sides to provide ventilation for carrying away the heat from the lamps.

So much for the cabinet itself. The really novel part of the arrangement, other than the lamps, is found in the door, which projects about ½ in. beyond the cabinet all around. It carries the conventional mirror which, incidentally, should be of plate glass. In addition to the mirror, two 2½ by 4½ in. windows of opal glass are placed so that they will be directly over the lamps when the door is closed. They diffuse the light.

Probably the best door construction is to build a wood frame of ¾ by 1½-in. stock with mitered corner joints and insert a plywood panel in the center. In the panel cut two openings to receive the opal windows. Cut the glass slightly larger than the opening and nail a rabbeted picture molding or similar strips around it on the inside of the door. The shaving mirror can be fastened by any convenient means. After hinging the door, apply a ball friction catch and a glass knob.

The outside may be finished in any way preferred, but the inside should be painted, enameled, or lacquered white or some light hue. Do not delay the finishing to the last; paint the inside before the electrical equipment is installed, and finish the outside before fastening the glass in place.



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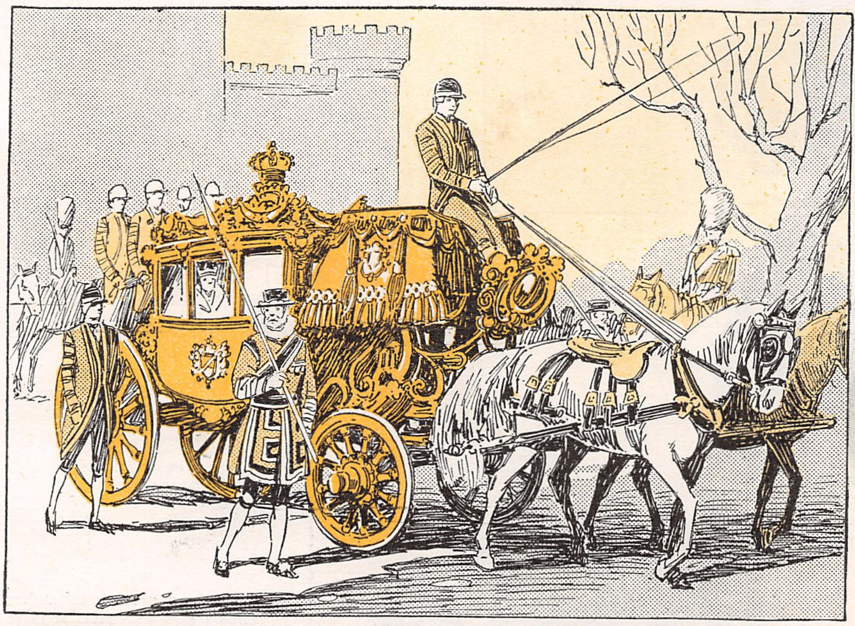
An Expert's Hints on How the Beginner in

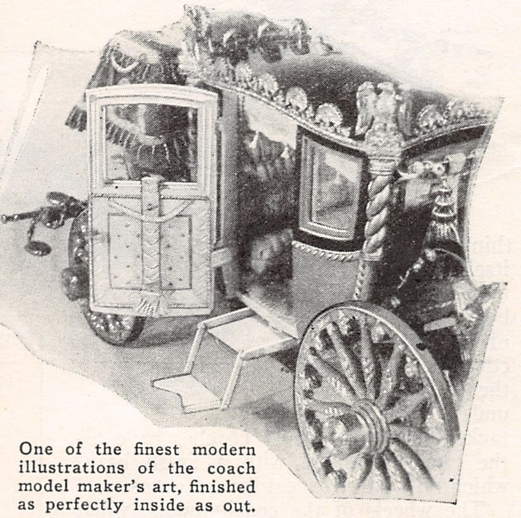
Coach Model Making

Can Save Himself Work

By
HENRY B. MATTISON



Old-time coaches, especially those used for ceremonial purposes, were of extraordinarily fine craftsmanship. To make a good model of one therefore requires skill and patience.



One of the finest modern illustrations of the coach model maker's art, finished as perfectly inside as out.

THE construction of coach models, so popular at the present time, offers many opportunities for the amateur craftsman to exercise his skill. He can simplify his work greatly and at the same time insure more accurate and workmanlike results by using methods and expedients such as those to be described in this article.

Although the following suggestions apply primarily to ornate models like the coach of which various details appear in the accompanying photographs, the same ideas can be adapted for use in building most coach models, regardless of their design.

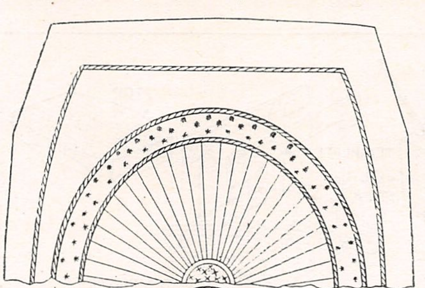
A good-looking coach may be made by carving the six main panels from wood rather than by attempting the built-up construction found in large coach bodies. The sketches at the bottom of page 98 show the first steps in this construction. Notice that the grain of the side and end panels runs horizontally instead of vertically. This is to insure strength for the thin sections above the window and doors.

In cutting out the doors, sufficient stock is removed to permit the gluing of a 1/16-in. strip along the sides of the door-hinge and lock pillars to strengthen the thin sections adjoining the windows.

Each panel may be held without injury to its edges by gluing or screwing a small block across its face. In the case of the side and end panels, screws may be used, as they may be inserted in the window opening, which will be removed when the windows are cut out. When working the roof panel, however, glue the block in place to avoid screw holes in the finished roof. After one side of each panel has been finished to your templates, remove the block, fasten it to the opposite side, and complete the carving of the panel

Hot glue is preferred by the writer in assembling the coach body. The assembled body should be sanded and immediately given a coat of thin shellac. This should be done promptly as it seals up the pores of the wood and prevents the warping and checking which are almost sure to occur when the body is allowed to stand unprotected even for only a few days. If the finishing is to be done with lacquer, a pyroxylin or lacquer type wood filler is recommended as a base for the lacquer. A porcelainlike finish may be obtained when lacquer is used over this filler.

As most coaches had their interiors completely upholstered, the interior decorating offers a considerable problem to the coach builder. The pleated designs, however, can be worked over wooden forms. In sewing the upholstering in place over these shaped wooden blocks, the needle usually can be pushed through the wood (especially if balsa) without first drilling the blocks.



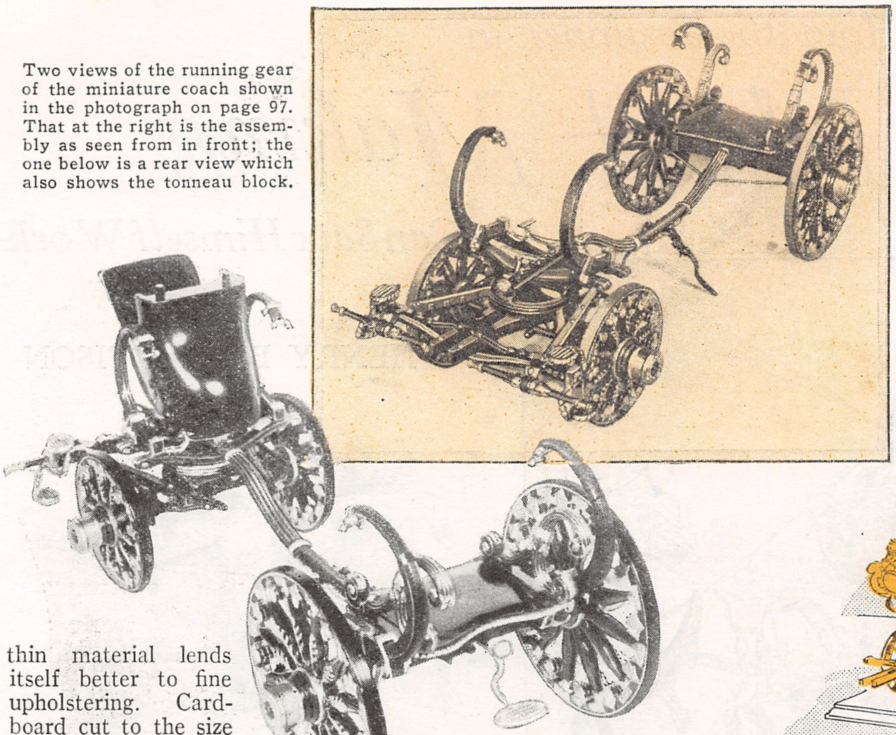
A typical design and cross section of the upholstered head lining (ceiling) for a coach.

Sponge rubber also can be used for the cushion backs. The thread knots in the design serve to shape the rubber to the desired form. Rubber used in this way must be set in a shallow box the size of the bottom of the cushion. Holes should be drilled through the bottom of the box to permit the needle to pass through in sewing.

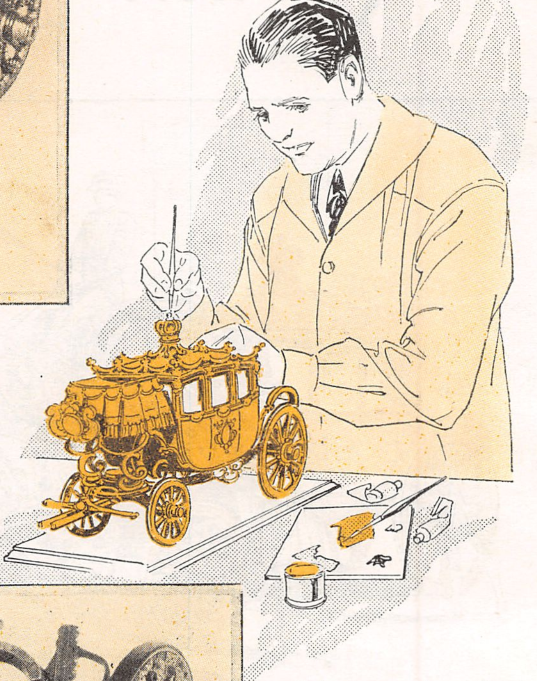
The majority of coaches built for royalty had intricate designs on the ceiling. A typical design is shown in one of the accompanying drawings. Since it is of a raised pattern, considerable difficulty was encountered in getting the padding properly placed and making the cloth fit tightly around it without wrinkling. A printer's matrix of papier-mâché was found to make the best foundation. First, a full size ink drawing was made of the design; then a zinc etching was made from this and the "mat" was prepared from the zinc. Any engraver can make the zinc etching and at the same time can direct you to some type foundry or printing plant which will press out a suitable matrix.

Possibly the paper used in making "mats" (obtainable in the stereotyping department of any newspaper) can be worked directly by hand, eliminating the expense of a zinc. This would require a little experimenting, while the first method has proved successful.

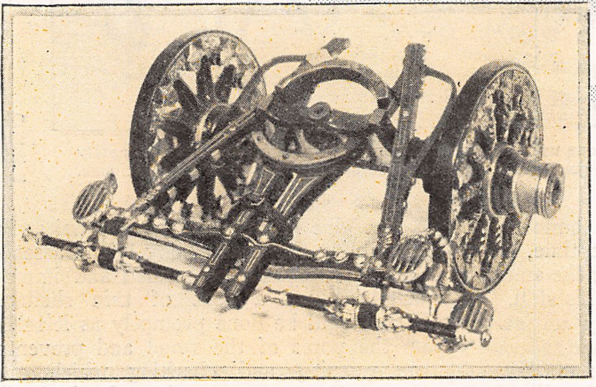
In covering panels and designs, use a thin, fine material. You will find that



Two views of the running gear of the miniature coach shown in the photograph on page 97. That at the right is the assembly as seen from in front; the one below is a rear view which also shows the tonneau block.



Only the expert model maker knows how essential it is to take pains with the painting.



The assembled front gear and wheels. Constructing the wheels is an exacting test of mechanical skill.

thin material lends itself better to fine upholstering. Cardboard cut to the size of the panel may be covered, the edges of the material turned under, and the panel tacked in place. Most coaches have all the panels outlined with a finish braid which will hide the cardboard edges.

The wheels of the coach model, when built up individually, will test the skill of the best of craftsmen. The photographs indicate to what length old-time coach builders went in decorating the finished wheel.

On the model illustrated, the wheels were built up by using six felloe blocks for the rear wheels and five for the front. The spokes were beveled and fitted into recesses in the hubs.

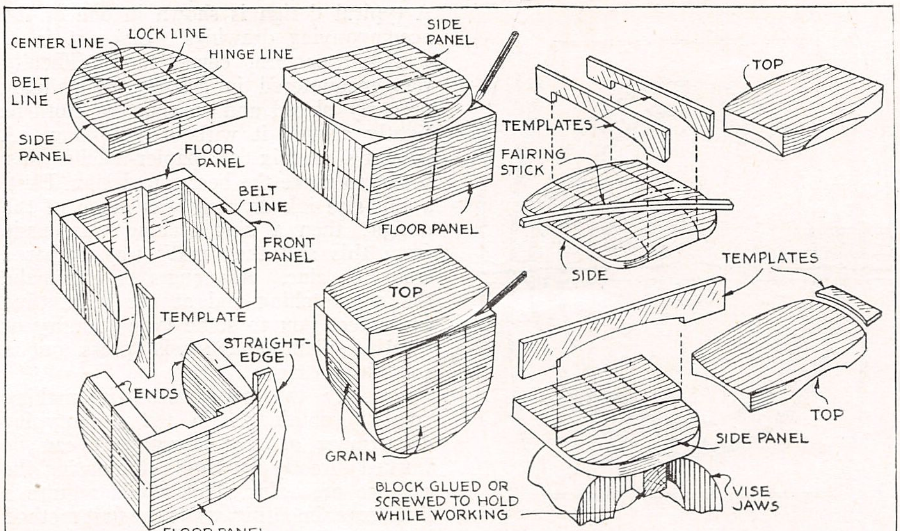
The construction of the wheels probably would discourage the beginning coach maker unless he could find a short cut. As a rule the easiest way to obtain a highly ornamented wheel is by casting it. This requires two patterns, one for the front and one for the rear wheel. The felloe blocks may be made up in sections and assembled to form the pattern, or the entire assembly can be turned from a solid piece of wood. The spokes for each wheel must be exactly the same if they are to fit together neatly. By making a pattern of one spoke for each wheel and casting the necessary number of aluminum spokes, you can reduce this work to a minimum. Don't forget to allow for double shrinkage, one for the pattern and one for the finished wheel.

The hubs should be turned up and glued in place at the center. Allow plenty of stock for turning. No attempt should be made to core the center hole, as this can be best drilled out when the castings are being turned. The inside half of the hub is made at least 1 in. longer than called for in the drawings, and this extra stock is used for chucking the finished casting. The design on the felloe shoes, spokes, and the like are, of course, worked into the patterns and are cast in the wheel.

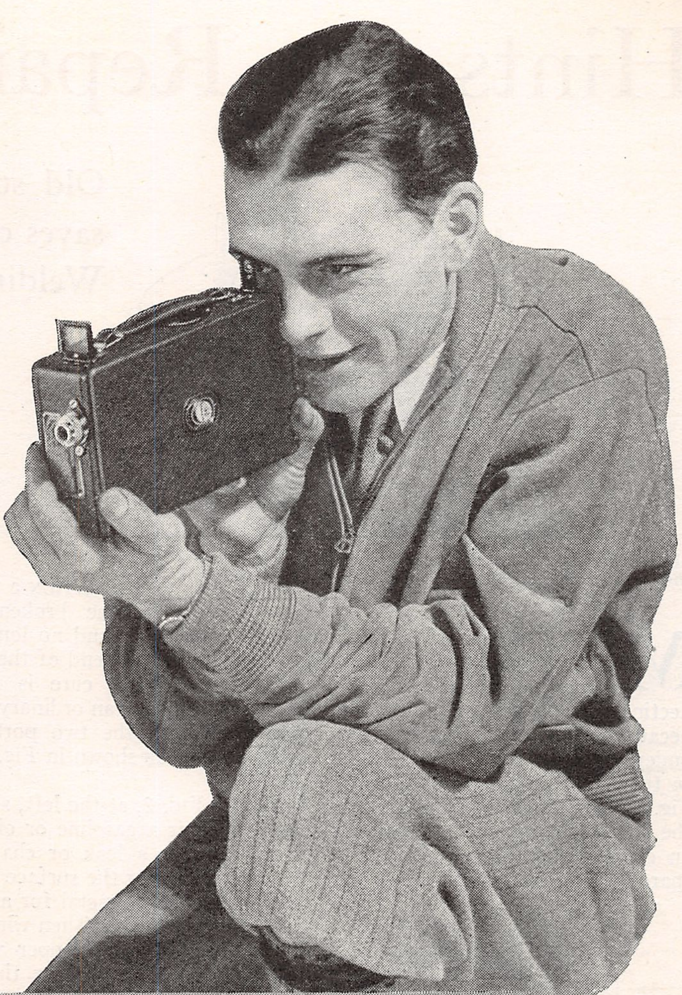
Once the patterns are made, the wheels themselves can be cast in aluminum and turned in a lathe. Next, the designs are brought out by the use of small files, hand chisels, and scrapers, and the wheels are ready for painting.

In making the metal leaves and other designs on the patterns for the wheels, printers' lead slugs may be used. These can be hammered out to the required thickness and the desired design quickly worked into them. Slugs may be used also for such decoration and braces as go on the coach itself, if prepared by the method just described.

Twisted beading offers somewhat of a problem. Copper wire twisted together and set into a half-round groove cut into the body will give the desired effect. This method will require careful filling of all the extra space in the groove with some high-grade commercial preparation.



These diagrams show the principle of building up any type of coach model body from six panels, which are cut with the aid of templates made from whatever drawings are being used.



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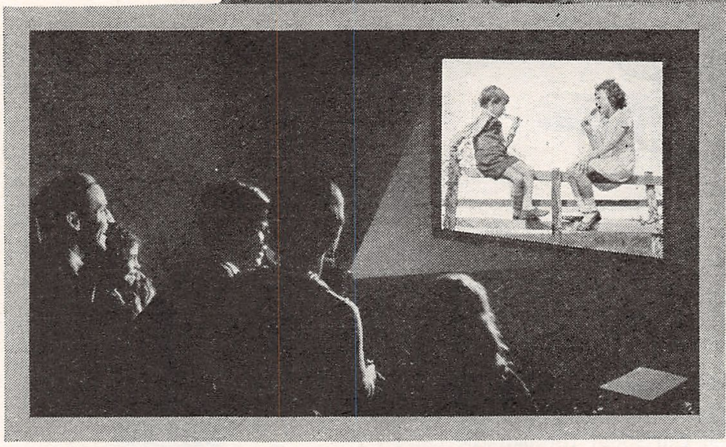

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Hints for Repairing Your Car

Old steering wheel with hand crank attached saves crawling from under car while at work—Welding rod can be used to remove broken axle

Popular Science Monthly awards each month a prize of $10, in addition to regular space rates, for the best idea sent in for motorists. This month's prize goes to H. P. Swope, Danville, Pa. (Figure 4). Contributions are requested from all auto mechanics.

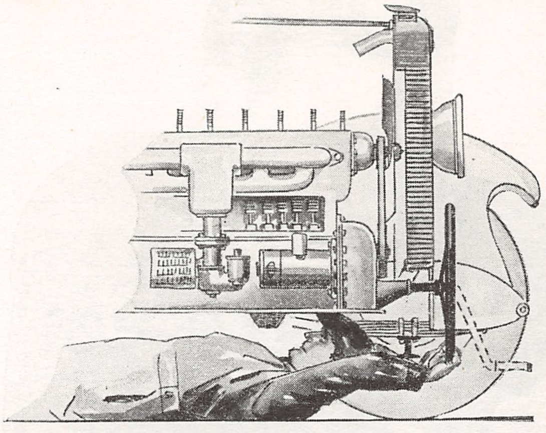

Fig. 1. How to attach hand crank to old steering wheel and save time in adjusting connecting rod bearings.

MANY jobs around a car make a man wish he could be in two places at once. Adjusting connecting rod bearings is one of them because it is necessary to crawl out from underneath the car every time you want to turn the crank to a different position. Fig. 1, above, shows a simple way to turn the crank and remain under the car. Get an old steering wheel and fasten it to a spare hand crank.

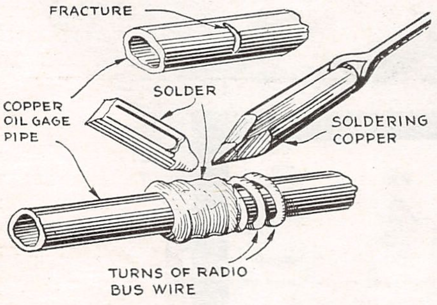
FRACTURE
SOLDER
COPPER OIL GAGE PIPE
SOLDERING COPPER
TURNS OF RADIO BUS WIRE

Fig. 2. Leak in pipe line can be repaired by winding wire around pipe and soldering.

Punctures are hard enough to locate without having to spend time doing the job all over again if you happen to loose the place. Fig. 3, below, shows an easy way to prevent "losing" the hole and at the same time deflate the tube. Stick the end of an old oil can spout through the puncture.

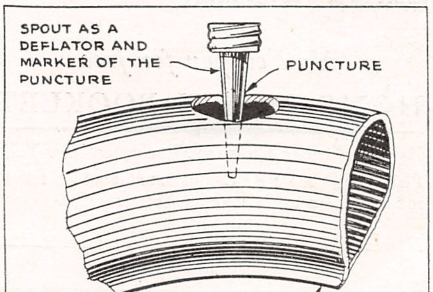
SPOUT AS A DEFLATOR AND MARKER OF THE PUNCTURE
PUNCTURE
INNER TUBE
ORDINARY OIL CAN SPOUT

Fig. 3. When a puncture is found in a tire you can keep it located with an oil can spout.

When a valve spring breaks, the broken pieces turn into each other and no longer exert any pressure on the end of the valve stem. While the correct cure is replacement, in an emergency an ordinary washer can be used to keep the two portions of the spring apart as shown in Fig. 5, at the right.

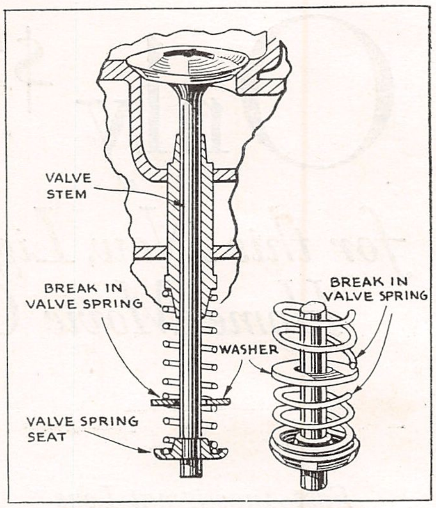
VALVE STEM
BREAK IN VALVE SPRING
BREAK IN VALVE SPRING
WASHER
VALVE SPRING SEAT

Fig. 5. When a valve spring is broken, it can be repaired temporarily with a washer.

Fig. 2, at the left, shows a good way to repair a gasoline or oil pipe line that has sprung a leak or chafed through. First sandpaper the surface of the pipe down to the bright metal for a half inch each side of the leak. Then wind radio bus wire or No. 14 bare copper wire loosely around the pipe to cover the polished portion. Flow solder over the wire and pipe.

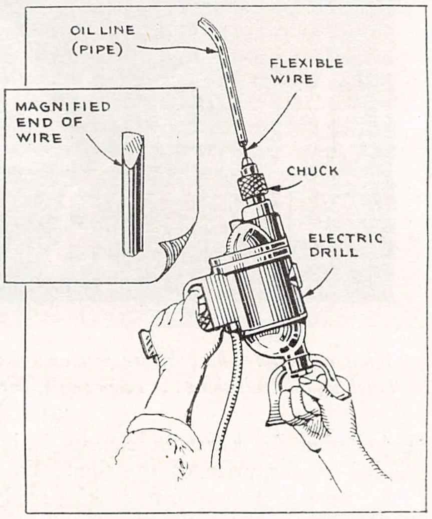
OIL LINE (PIPE)
FLEXIBLE WIRE
MAGNIFIED END OF WIRE
CHUCK
ELECTRIC DRILL

Fig. 4. Clogged oil lines can be cleared by use of a piece of piano wire, with chisel shaped end, inserted and then rotated.

When air pressure fails to clear out clogged oil lines try the method shown in Fig. 4, at the left. Take a piece of flexible wire, preferably piano wire, and grind one end chisel shaped as shown. Stone off the corners to prevent it from cutting into the pipe at the bends and use an electric drill or a hand drill to rotate it.

The method of removing the remaining portion of a broken axle by means of a "lasso" of wire has been shown in a previous number of Popular Science Monthly. In many cases the axle breaks off so short that the "lasso" can't be used. Fig. 6, below, shows a way to weld a rod to the stub so it can be pulled. An arc is drawn and then the welding rod jammed against the axle stub as the switch is opened.

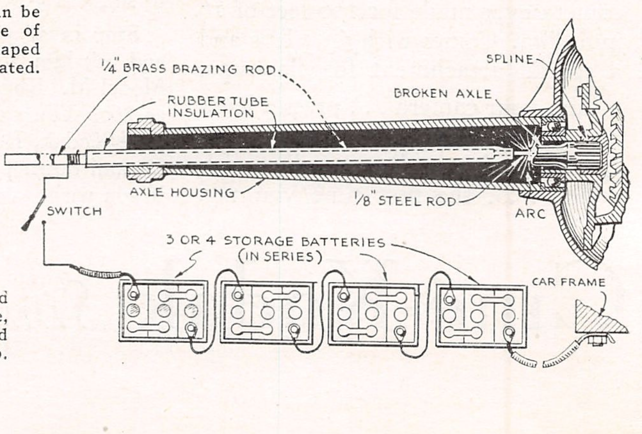
1/4" BRASS BRAZING ROD
RUBBER TUBE INSULATION
SPLINE
BROKEN AXLE
AXLE HOUSING
1/8" STEEL ROD
ARC
SWITCH
3 OR 4 STORAGE BATTERIES (IN SERIES)
CAR FRAME

Fig. 6. A rod can be welded to the stub of a broken axle, as shown at the right, and used to pull out the stub.

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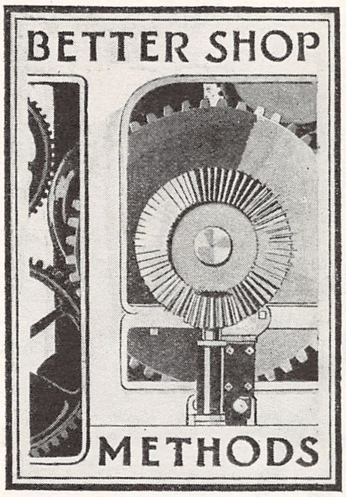
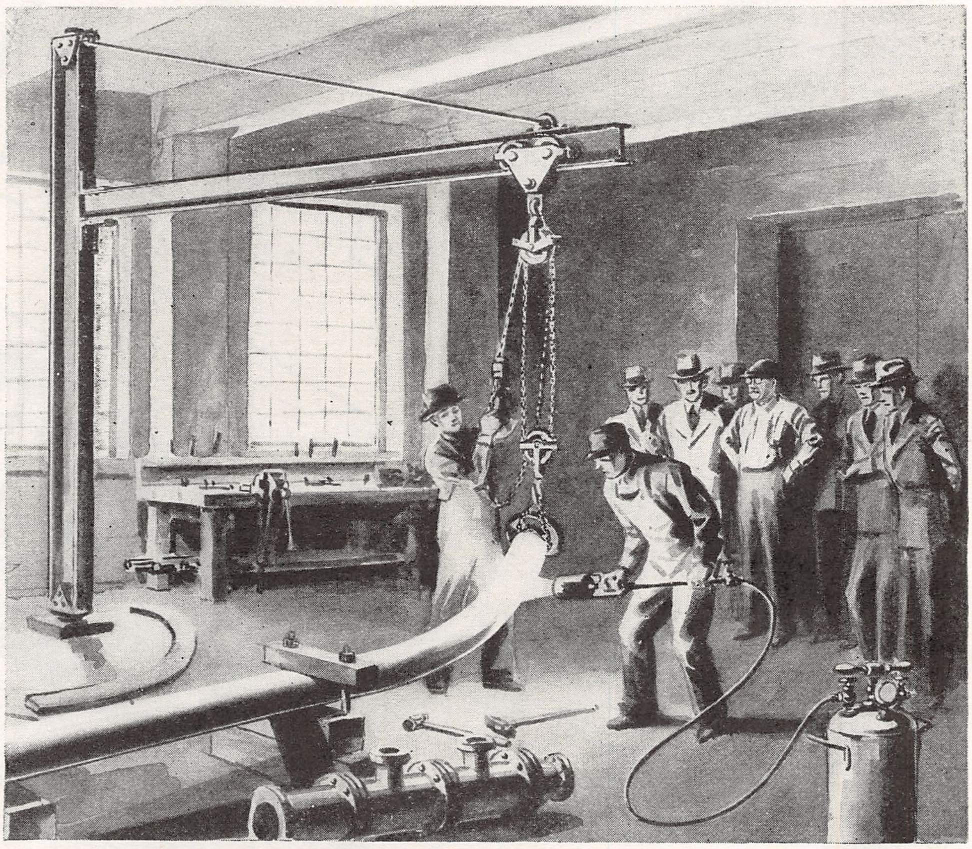
Old Bill Bends a Big Pipe *and* Does Some Welding



By JAMES ELLIS



As the professor and the boys stood by and watched the two mechanics in the blacksmith shop, Old Bill described the process, which consisted of heating the pipe, bending it a little, and repeating the steps.

OLD BILL couldn't honestly say he was looking forward to playing host that afternoon, but there was no escape. A group of engineering students from the State University would be in shortly to look around. They were making the regular yearly visit to a carefully selected list of shops and factories with the hope of learning something that otherwise could not be taught—just how the country's work was done.

Too bad they hadn't picked another time. Even a veteran of Old Bill's machine shop experience has his moments of despair, and early on the morning of this chilly day he had encountered as hard a problem as any he could recall. For a while he thought he had for once spoken too hastily in saying just when he would get the job finished.

Some large cast-iron pipe fittings had broken in the power house of one of the plants in town. No one had been hurt, but there were no similar fittings within two hundred miles; and even if they were replaced, exactly the same accident would happen again.

Truly, a job to try Old Bill's powers. No wonder he sighed at the thought of entertaining visitors. He was still wrestling with the problem and discussing it with the plant superintendent when Professor Robinson and his boys made their appearance.

"Good afternoon, Mr. Robinson," Old Bill greeted his friend. "I see you have come to look us over again."

"Yes, just a few of us. We drove up this morning, but there are only five of the boys with me, so it will not be such a crowd in the shop."

"I never tire of showing people what we are doing," Old Bill assured him, "especially when it is someone who is really interested and knows what it is all about."

"These boys are genuinely interested in machine shop work, I am sure," the professor returned, "for we have just lately been working hard in a class of machine design, which is something you have to know a great deal about these days."

Old Bill led his little group of visitors out into the shop. He felt that it was just as well to let them look about for themselves at first. After about half an hour, however, the entire group assembled by mutual consent in the blacksmith shop where a large piece of pipe was being bent.

"Here is the sort of job that keeps me scheming all the time," Old Bill explained to the professor. "It is not the sort of thing that we can do best, but one of the occasional jobs that we must tackle. We are making that pipe bend because someone failed to look carefully enough into his design a few years ago. This morning some fittings broke at a local steam plant because everything was too rigid and no provision had been made for expansion when the steam heated the piping. The result was an accident that might have injured or killed someone. We are making this bend to give some flexibility to the piping in order to prevent another accident."

Old Bill paused while his mechanics hammered out a buckle that was just beginning to form on the side of the pipe.

"This is a method of bending large pipe that we sometimes use," he said, addressing the students. "We do not fill the pipe with sand, but depend on careful control to keep the pipe section round as the work progresses. As you see, the equipment is simple. The pipe is heated with the torch at the point where the bending should be done, and the chain block is taken up a little. Then another portion of the pipe is heated to make more of the bend, and the chain is taken up again. In case there is any flattening or buckling of the pipe, it is carefully hammered out as the work progresses. It may not be as quick as having a furnace for heating the whole bend at one time, but it is a method that can be used in a shop such as this where the equipment is limited."

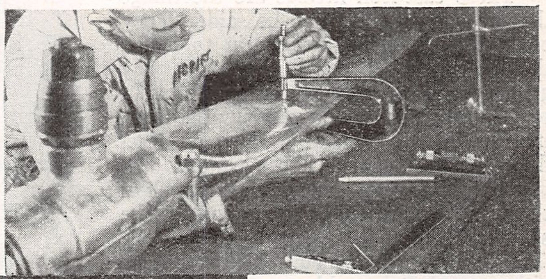
The students were quick to grasp the details of the method. They saw how the pipe was anchored to the floor and supported on blocks so that is was accessible. One of them pointed out that the same procedure could be used if the pipe were on the floor, but that it would not be as convenient to work upon.

"One point worth noticing," Old Bill continued, "is that we heat the outside of the bend hottest, so that the metal will stretch on the outside rather than compress on the inside. In that way we avoid most of the wrinkles."

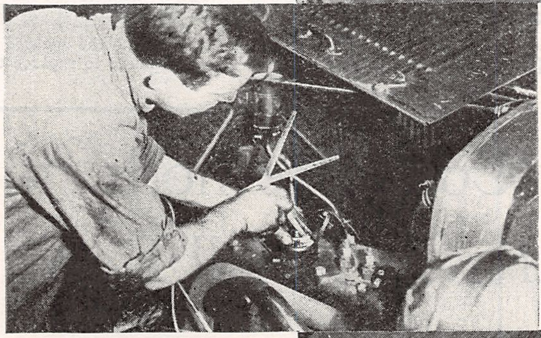
Not far from where this bending was

Starretts

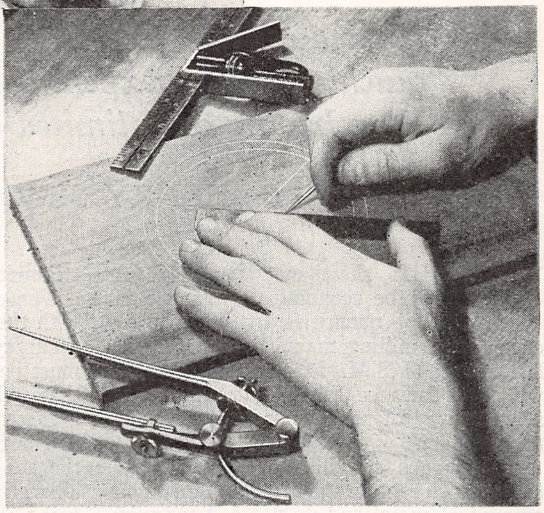
for your plane



car



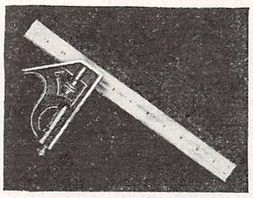
coach-model



Above: Checking propeller blade with a Starrett Micrometer No. 222.

Left: Setting breaker points with a Starrett Thickness Gage No. 172.

Below: Laying out felloes for coach-model wheels.



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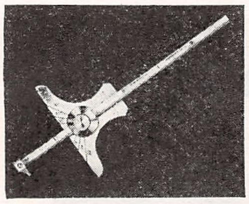
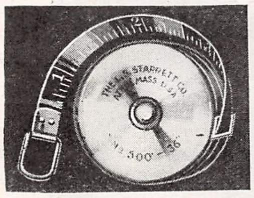
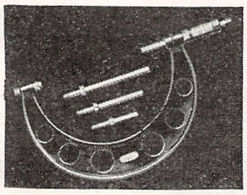


Combination Depth Gage and Hook Rule No. 236 H — another handy tool — caliper — depth gage plain rule - book rule - handy protractor —$2.50.



Pocket Steel Tape No. 500 — graduated in inches and 16ths — nickel plated case — strong, flexible steel ribbon — 36" size: $.75 — 120" size: $1.90.



Micrometer Caliper No. 224-AA — range 0 to 4" by 1000ths — a general-purpose mike — without ratchet stop: $18.00.

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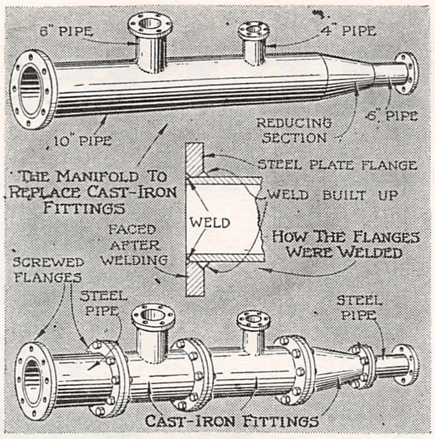
being done, a welder was at work making up a steel pipe manifold to take the place of the cast-iron fittings. (These are illustrated in one of the accompanying drawings.) Old Bill pointed them out.

"Those cast-iron fittings are the things that caused the trouble," he said. "They could not stand the overstrain to which they had been subjected, and finally they gave way. We did not have anything to replace them, so we are making up a manifold of steel pipe and welding on steel flanges, which will be a better job."

"Do you have to use the electric welder to make a joint like that?" one of the students asked.

"No," Old Bill replied. "You could use either an electric weld or a gas weld for steel pipe."

The keenly interested group spent some time watching the progress of the work on the new manifold and observing how the steel flanges were being welded in place.



The cast-iron fittings and the welded unit of steel pipe that was made to replace them.

Finally, the tour was at an end. Old Bill felt content; he was satisfied now that his promise about finishing the work in the shop would be kept.

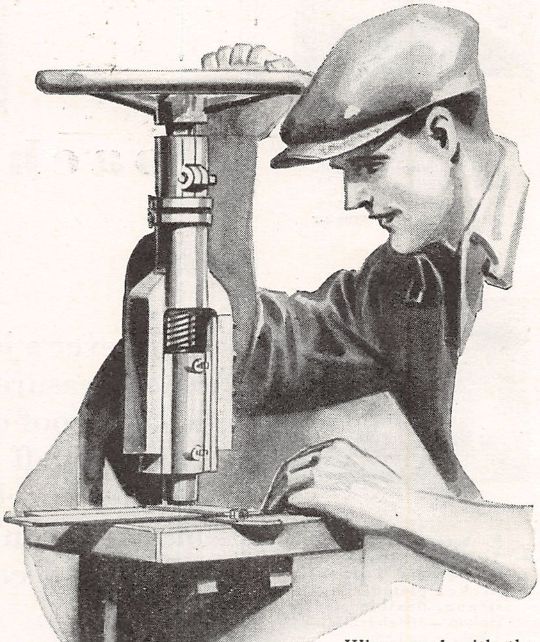
Mr. Robinson said, "I am very glad that we came today, for I don't know when we could have found anything more instructive. I am especially pleased that the boys have seen the welded piping, for I have been telling them lately that that is a very modern development, and I wanted them to see some of it."

"In these times the work goes to the man who can get it out at the best cost, and we have to keep up," was Old Bill's final comment as he waved good-by to his visitors.

Two Low-Cost Methods for Blanking Sheet Metal Parts in Small Lots

How duplicate pieces can be shaped quickly and inexpensively in the shop having only limited equipment

By HENRY SIMON



When used with the dies in Fig. 2, the screw press offers a solution to your blanking problems.

WHILE sheet metal parts often may be economically blanked in small quantities by using a fly cutter in a milling machine as described last month (P.S.M., Mar. '31, p. 106), it will sometimes be found that grinding is a better way of producing the final shape than milling.

The shapes suitable for grinding are those which require the removal of a small amount of metal and do not call for very sharp corners, like the examples at *A*, Fig. 1. Grinding is an excellent way to finish filed or shaped parts.

The secret of success with such form-grinding lies in being able to dress the wheel quickly and with dependable accuracy. A simple tool for doing this is illustrated at *B*. A regulation diamond tool *a* is clamped in a cast-iron stand *b* so as to bring the point of the diamond and the point of the foot of the stand exactly in line vertically. The wheel template *c*, shown in detail at *C*, is made from soft steel to the accurate wheel form desired, and is clamped in the T-slot of the grinder table ahead of the vise that holds the work. To trim the wheel, the table is run forward and raised to where the diamond point is horizontally about in line with the wheel center as at *D*. All that is necessary then is to run the trimmer along the template.

The wheel can be retrimmed with the assurance of complete accuracy in a few seconds. It must be remembered, however, that unless the diamond point is exactly in line above the point of the foot as shown at *E* and the shape of both is precisely alike, the result cannot be correct. A try-square should be used to adjust and set the diamond point as at *F*.

It goes without saying that no sharper corner than the radius of the diamond point can be produced. On the other hand, so long as these conditions are fulfilled and the trimmer is held down flat, no special care is needed in guiding it.

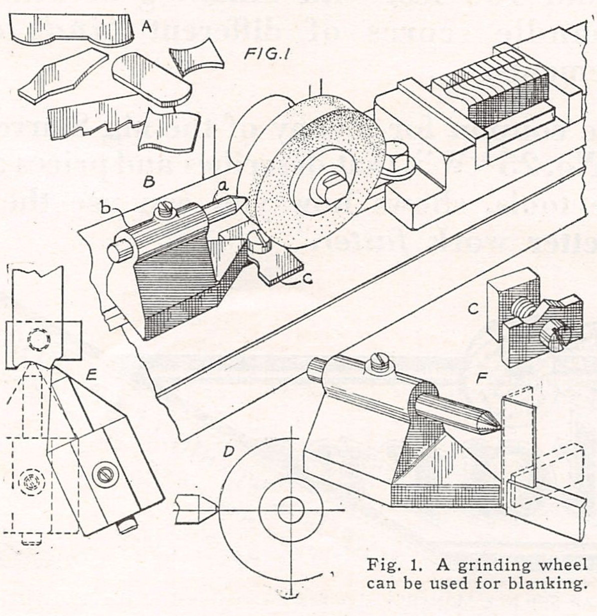


Fig. 1. A grinding wheel can be used for blanking.

With all the methods heretofore outlined, there still remains a large demand for a regular punch and die so cheap to make that it will pay to make them for even a few hundred pieces. And it can be done, provided the parts are of thin metal and are not harder than a mild sheet steel.

A set of tools of this kind is shown in Fig. 2. The remarkable thing about it is that both the punch and the die are themselves made of sheet metal, the thickness varying according to the work required of them. A good material is "ground flat stock," which is a flat tool steel sold by several large toolmakers ready ground to size in any thickness up to ¼ in. and in different widths up to 6 in.

The die *a* is a piece of stock of generous length lying flat upon a surface block to

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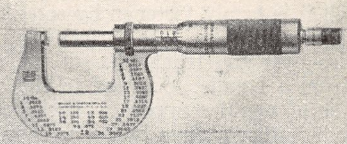
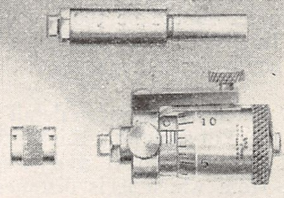


Micrometer Caliper No. 12 RS
Range 0 to 1" by thousandths
Distinctive shape of frame permits its use in places inaccessible to ordinary micrometers.



Inside Micrometer No. 263
Range 1" to 2" by thousandths
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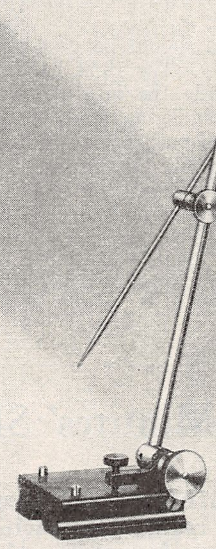

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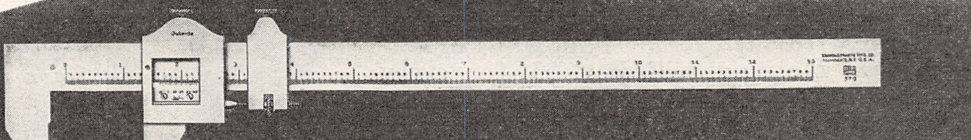

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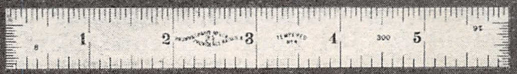

Tempered Steel Rule
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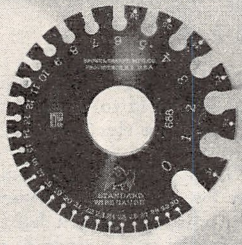
Blades are double ended; concave and convex radii of same size are on the same blade.



American Standard
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For gauging sheets, plates and wire of non-ferrous metal.

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which it is firmly fastened by screws *b* at the rear end only. The forward end protrudes over the front edge of the block to form a handle. Screwed to the die is the sheet metal stripper *c*. The spacer *d* may be either a plain block, as shown, or it may be extended into a stock guide. In metal of any thickness, the check screw *e* prevents the die from being raised more than enough to allow the blank to be knocked out, if the pull of the stock on the stripper should be too much for the hand. In that case, a tap with a hammer on the handle frees the punch of the metal.

THE punch *f* is shown in detail at *B*. It is a piece of somewhat thicker flat stock carried on the face of a regular punch holder, from which it is distanced by a roughly shaped, soft steel spacer *g*. The die should be given a generous clearance, about 2° to 3° on a side, as shown at *C*. A small die of the same kind, made with a flat-stock base and showing all details, is illustrated at *D*.

Dies like this should be used under a screw press only. The right hand works the spindle, while the left operates the die. As the spindle descends, it blanks out the piece and pushes it down upon the surface of the block. As the spindle rises, the die is held down with the hand to prevent it from jumping up under the pull of the metal against the stripper. When the punch is clear of the metal, the die is raised enough to allow the blank to be pushed out with a strip of fiber or sheet metal *h*. It is then allowed to drop back, and the cycle is repeated.

Though the operation is a little slower than punching with regular tools, it is still very fast compared to any other method. On the other hand, the tools are quite inexpensive. Punch, die, and stripper are easily and quickly made. Because there is solid metal all along under the die, the strength of the die is much greater than might be thought.

A convenient thickness for ordinary work is ⅛ in. for the die, and about 3/16 in. for the punch. Contrary to ordinary practice, the die should always be drawn to a purple or blue temper, and from 50° to 75° F. softer than the punch, as indicated at *C*. Ample metal should be left around the hole in the die to prevent bursting and cracking. Clearances are the same as in ordinary die practice, and the work is of the same quality.

This article concludes Mr. Simon's discussion of blanking sheet metal parts.

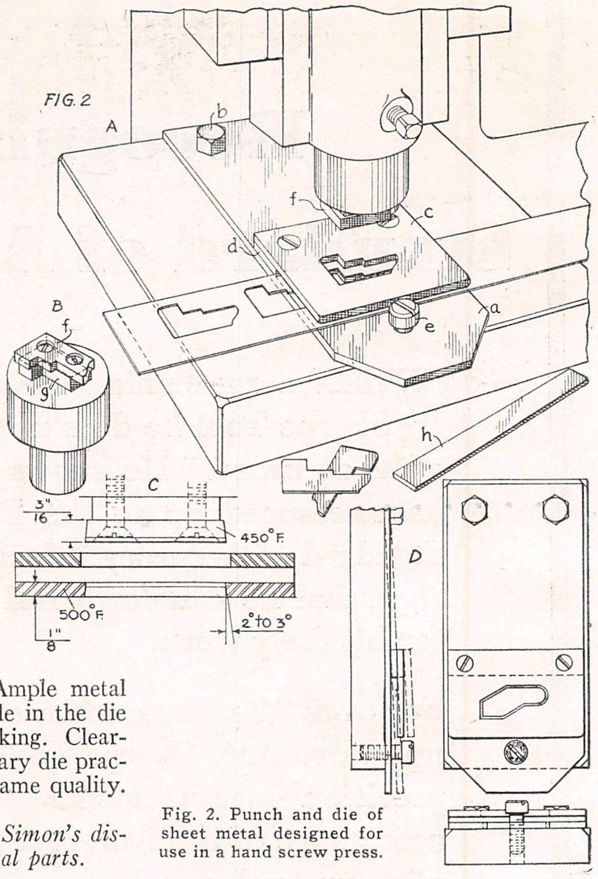


Fig. 2. Punch and die of sheet metal designed for use in a hand screw press.

Two Minutes' Shop Talk *with Old Bill*

OLD BILL would like to hear from his readers regarding machine shop kinks that they have found of value. He would prefer short letters of about 300 words, illustrated with sketches or photos. *Popular Science Monthly* will pay $3 for every letter published, with an extra allowance for each photograph used. Address your letters to "Old Bill," *Popular Science Monthly*, 381 Fourth Avenue, New York.

A DISCARDED needle file ground to a three-sided point forms an excellent substitute for a prick punch. In use, place the point on the desired mark and rotate the file between the thumb and forefinger, supplying at the same time a slight downward pressure on the tool.

A hardened steel part should not be struck with a hammer, as the lightest blow, if struck along an edge, is liable to fracture it.

If the proper forms are made, an electric hammer can be used as a timesaver in hammering forgings, in welding on the anvil, and in driving home keys and bushings.

The most important job in the shop is of no importance if you are too important to coöperate with others.

When using a tungsten-carbide tool never stop the machine without first disengaging the feed.

In an emergency, a cupped set screw will be found to be an excellent substitute for a rivet set.

Glass hardness without brittleness can be obtained on your scraper by heating the tool to a light cherry red, forcing it into a piece of yellow soap, allowing it to remain there until it becomes black, and then completing the quenching in water.

Oxygen and acetylene tanks should be well braced if they are to be used or stored in an upright position.

A good press or drive fit demands that the hole be bored or reamed with painstaking accuracy.

HOW TO MILL SMALL, DEEP CAVITIES ACCURATELY

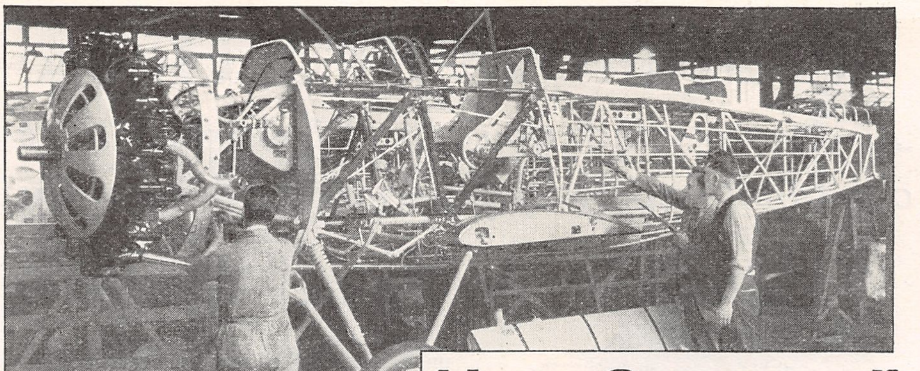
NEEDLESS spoilage in the construction of die-casting and forging molds can be eliminated if the machinist who is assigned the job understands a few kinks.

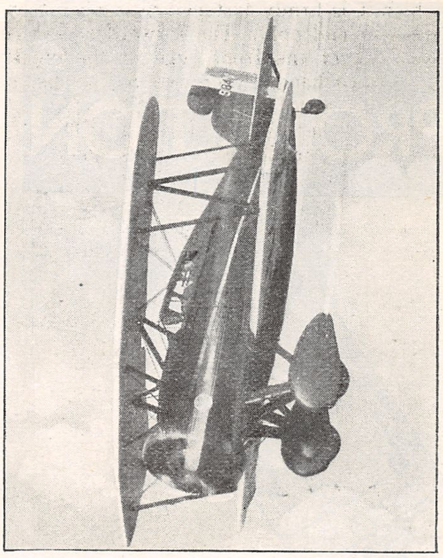
Let us say, for example, that it is required to sink a small circular cavity into a die block. A mechanic who is unfamiliar with this type of work will, in most cases, make a special tool that is too nearly the same diameter as the cavity, allowing only for hand finishing after the milling. With this tool in the miller he will try, without any further preparation, to sink the tool in the die only to find that the work on completion is so rough and out-of-round that it is useless.

The first step in work of this kind is to make the special tool considerably less in diameter than the desired final dimension of the cavity. Also, the tool should be stoned after hardening in order to insure a smooth finish on the work. Set up the die block in the vertical miller so that it can be revolved; then carefully center the cavity to be milled, and drill a hole smaller than the smallest diameter of the cavity into the block to the desired depth. With this preparation, the form tool, which is less than the finished diameter, can be sunk into the block without difficulty. By revolving the work and using the cutter sideways, it is possible to finish the cavity to the exact diameter.

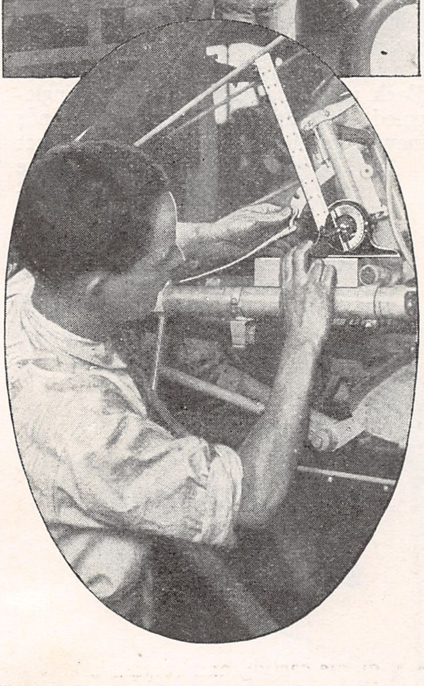
A small mouth blowpipe can be used to free the cutter of chips.—F. GLOWZEWSKI.

TO FIND the length of travel when milling a spiral slot, wrap a flexible piece of strip stock of the correct width around the shaft the desired number of turns.





How Crosswell Dove To Earth at 300 Miles Per Hour



Bill Crosswell, Curtiss test pilot, flies all kinds of new ships that never flew before. One is the famous "Hell Diver" in which he roared downward for 2½ screaming miles in 30 seconds. But before Crosswell dove at this breakneck speed, a thousand and one little acts of infinite precision went into the plane that carried his precious life. Skilled airplane designers, engineers and craftsmen made every tiniest part with the aid of the finest precision instruments known to modern man. Pulling out of a terrific dive puts tremendous strain on all parts of the plane. Precision tools contribute to air-worthiness under these trying conditions. For example, in the oval above we see John McCarthy, mechanic in the Curtiss Buffalo Plant, setting the rudder pedal of the "Hell Diver" with a Lufkin Bevel Protractor No. 635. Without absolutely accurate control at such tremendous speed, disaster might come. Lufkin tools do their part in making flying safe.

Lufkin Combination Sets are used in America's most exacting shops because they have so many improved features. These Sets consist of blade with square head or stock, protractor head and center head. The tempered blades are machine divided, markings being most legible. Lufkin Squares have ¼ in. longer bearing surface on the stock, and each surface is ground, polished and lapped. The square head has square and miter faces, and is equipped with level glass and steel scriber. *The bevel protractor is graduated 90° either way instead of the usual 180°—making it much quicker to read.* Center head determines the center of all cylindrical work. The arms of the center head, ground to equal length and ends uniformly machined, greatly increase the range of this tool by making possible accurate measurement on work of large diameter. The Combination Set has more applications in use than any other tool made for mechanics. *You can tell a Lufkin at a glance by the distinctive color of the enameled parts—a handsome olive green.*

Top Left—Skeleton fuselage of famous Curtiss "Hell Diver" receiving its installation in final assembly line.

Top Right—Curtiss "Hell Diver" in the air, Bill Crosswell at the controls.

Oval—John McCarthy, Curtiss mechanic, setting rudder pedal of the "Hell Diver" with a Lufkin Bevel Protractor.

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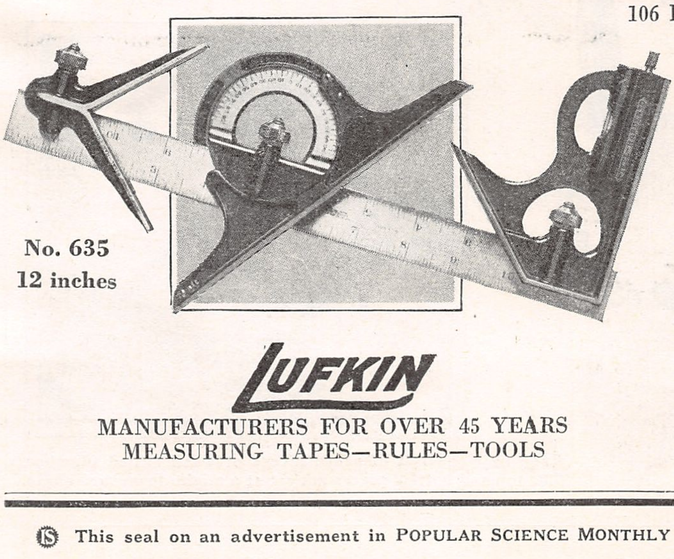

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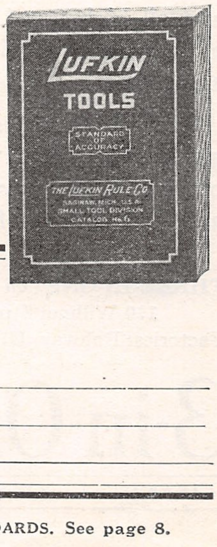

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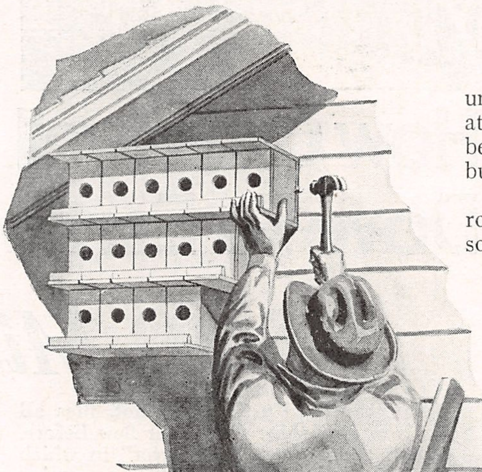
CLEANS - OILS - PROTECTS

A Multiple Bird House to which you can add as many little one-family apartments as you find necessary

By
JOHN C. WORKLEY

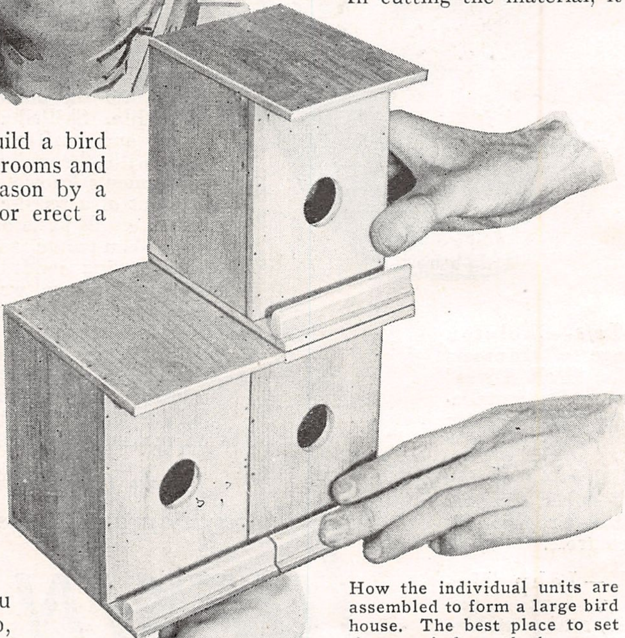


DID you ever build a bird house with twenty-four rooms and have it occupied all season by a single pair of wrens; or erect a one-room bird bungalow, and have a half-hundred anxious nest builders fight for its possession?

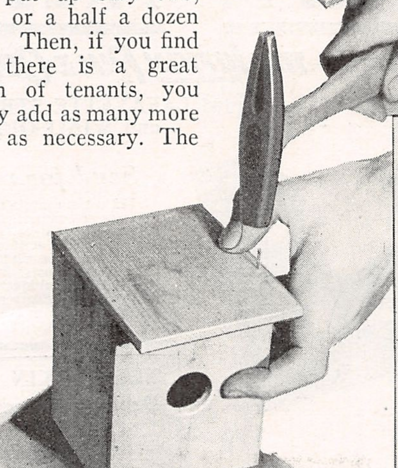
Such difficulties may be avoided by building a bird house that is made up of small units—a kind of add-a-room apartment. If you think that the bird population in your yard is going to be small, you need put up only two, three, or a half a dozen units. Then, if you find that there is a great inrush of tenants, you simply add as many more units as necessary. The units are so shaped that they can be added at the top, bottom, or sides. They are best fastened to a board or building wall, but can be mounted on a roof if desired.

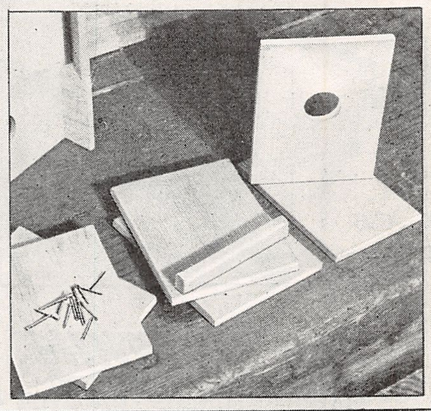
Each unit in itself is a small, single-roomed bird house. The size depends somewhat on the kind of birds you expect to entertain. Since wrens are among the most popular, the dimensions given here are for a unit accommodating birds of that size.

The outside dimensions of each unit are approximately 3½ by 3½ by 5 in. Wood ¼ in. thick is used, seven pieces being required. In cutting the material, it is



How the individual units are assembled to form a large bird house. The best place to set them up is beneath the eaves.





Each unit consists of seven pieces of wood nailed together. The top and bottom pieces are set at a slight downward angle.

easier to make enough pieces for a considerable number of units at one time.

The sidepieces are each 3¼ in. wide and 4½ in. long. The front board, which has a 1-in. hole bored about 2¼ in. from the bottom (measured to the center of the hole), is 3½ by 4½ in. The back is 3 by 4½ in., and the top and bottom are 3½ by 4½ in. Both the roof and the bottom slant downward at a slight angle —about 2½°—from the horizontal, the roof so that the water will drain off, and the floor so that one unit can be mounted on top of another. Therefore, in cutting the sidepieces, make the ends on the necessary bevel.

Finally, you will need a piece 3½ in. long and ½ in. wide, with one edge rounded. Placed along the front edge of the ledge formed by the projecting bottom, this strip provides a convenient perch for the bird residents. The front board, with the hole, covers the edges of the two sidepieces; the back is inserted between the sides.

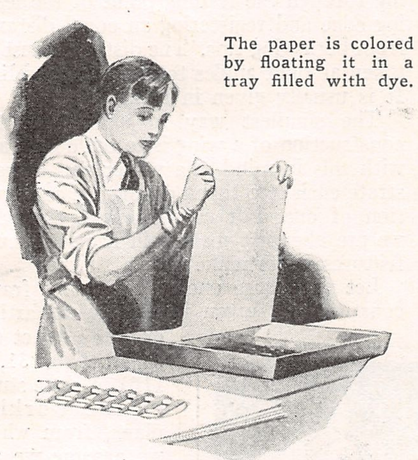
Nail the pieces together with small brads, and leave them unfinished. Paint, when used on bird houses, does more harm than good because its odor often keeps birds away.

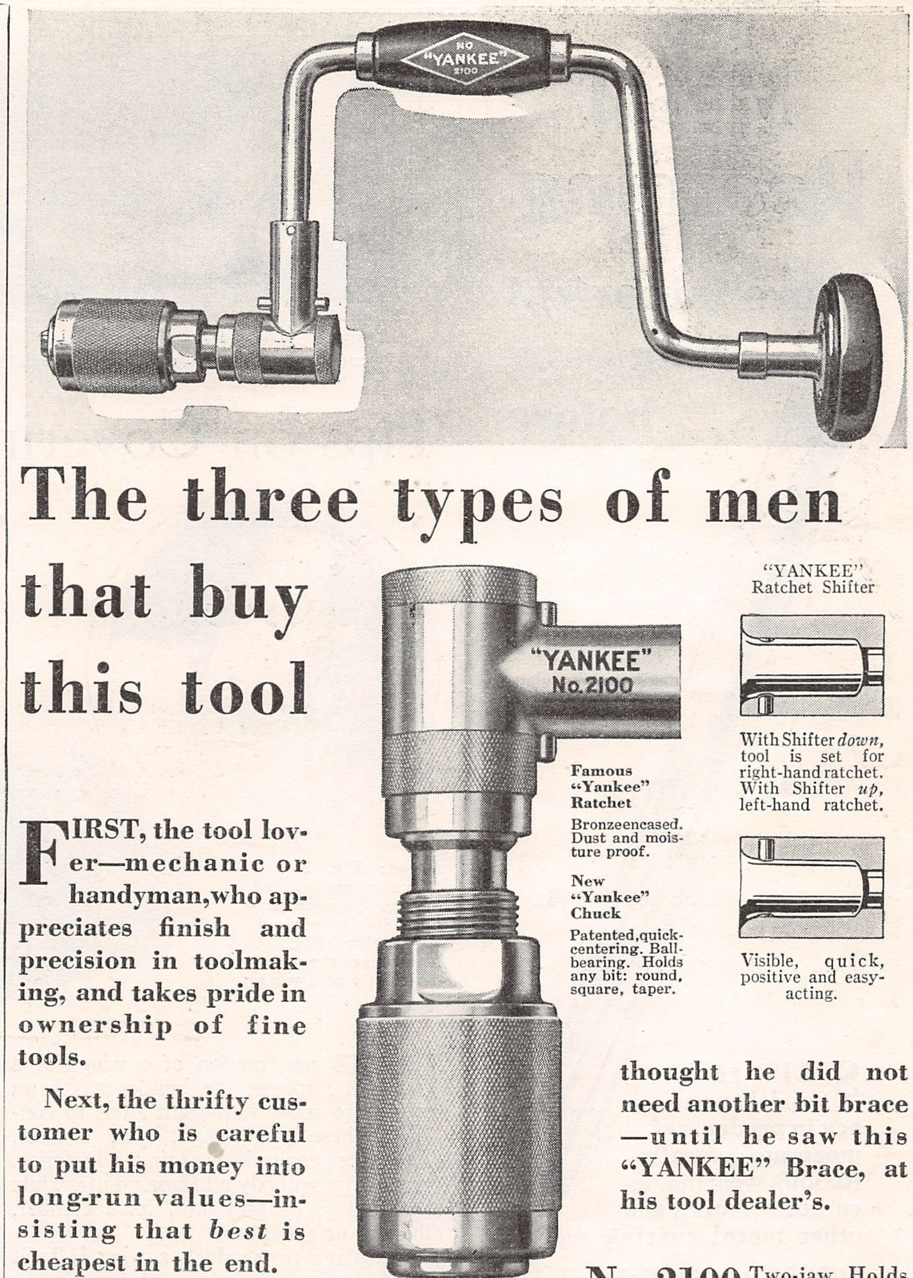
You can fasten the houses to a vertical surface by nails driven at an angle along the edges; or you can mount the units in rows on a roof or a platform surmounting a pole. Usually, however, a sheltered place, such as a point beneath the eaves of a building, is preferable.

DYEING PAPER FOR USE ON MODEL AIRPLANES

MOST model airplane enthusiasts have experienced difficulty in coloring the paper covering of their models. Colored dopes are fairly satisfactory, but they have a tendency to show streaks.

I pour hot water into a large tray to a depth of about ¼ in. and dissolve in it some ordinary household dye of the desired color. Then I float sheets of paper on the surface just long enough to become soaked, afterwards hanging them up to dry with the aid of spring clothespins. The paper is very wrinkled when it is wet, but it dries out all right, and then I iron it flat. It is best to dye long, narrow strips and do a number of them at a time so that they will all be the same shade.—JAMES J. DOYLE, JR.


The paper is colored by floating it in a tray filled with dye.



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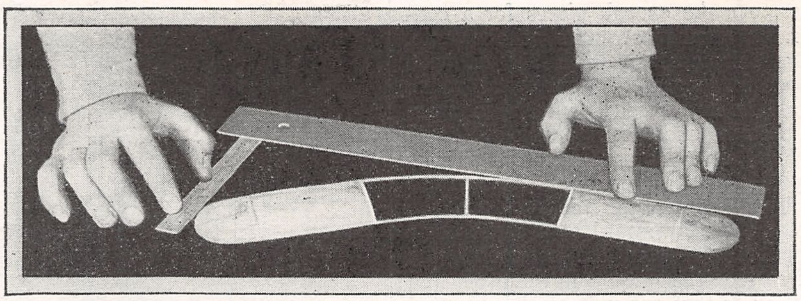
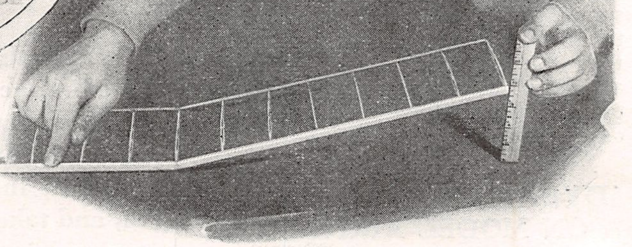


Fig. 1. How a straightedge and a scale are used to measure the sweepback of a model airplane wing. The scale should be at right angles to the straightedge.

Tips on Covering the Wings of Model Planes

By EDWIN T. HAMILTON



Above: Fig. 3. All tissue paper should be ironed smooth before it is applied. *At right:* Fig. 2. Measuring the dihedral angle of a wing.

IN THE construction of a wing for a model airplane, the builder has from four to seven important steps to consider. These are design, size, camber, dihedral, sweepback, covering, and finish. Some wings embody all these points, while others may, or may not, have camber, dihedral, or sweepback.

Any plans from which a wing is built will show these various points; or, in the case of an original design, the builder must decide on them before actual work is started.

Design has to do with the type of frame construction used to gain any desired appearance of a wing after it has been covered. The size refers to the length, width, and thickness of the wing. Camber, usually spoken of as "wing camber" or "rib camber," indicates the curve of the wing from its leading edge to its trailing edge.

Dihedral, or "dihedral angle," is usually measured in inches; it is the distance of each wing tip above a level surface upon which the center portion of the wing rests when in flying position. For correct measurement of this distance, both wing tips must register the same height above the imaginary level.

The term "sweepback" explains itself, inasmuch as it means the distance the wing extends backward from its own leading edge, or the distance it sweeps back. This is measured from a straight line passing through the leading point of the leading edge and registering an equal distance from both wing tips. The distance must be taken at right angles to this extended line. It is usually given in inches.

The simplest way to understand the construction of a wing is to build one, and with this in mind, the writer will demonstrate each step taken during the construction of one. For completeness, the wing we are about to make will have all seven features in its make-up.

Let us choose one of the many frame constructions given in a previous article on this subject (P. S. M., Feb. '31, p. 116). A close study of the working plans, from which we assume we are working, gives the proper width, length, and thickness of all spars, ribs, and leading and trailing edges. The desired rib camber is shown in the plan of the ribs, so that when they are cut to the proper shape, the

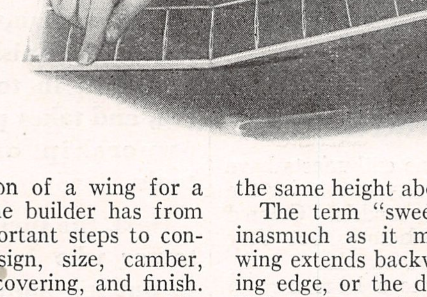


Fig. 4. In covering a double-surface wing, cut the tissue wider than twice the wing width.

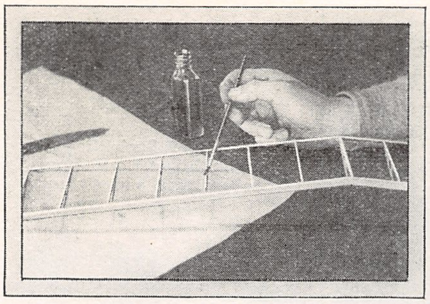


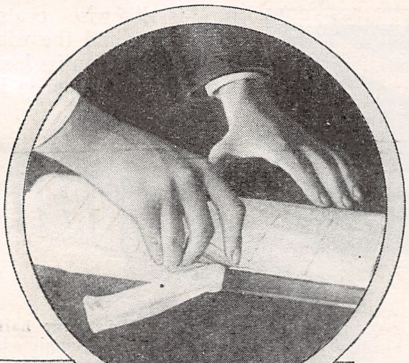
Fig. 5. Applying dope to the bottoms of the leading and trailing edges, spars, and ribs.

camber for the entire wing is also obtained.

Cut all parts to size. When finished, the first three steps—design, size, and camber—have been attended to. We now consider dihedral and sweepback. The former can be given the wing after its two halves have been assembled, but the sweepback must be planned before assembly. As good construction requires the ribs to run generally parallel to the length of the fuselage, it will be seen that if this angle is obtained after assembly, the ribs will appear at an angle with the fuselage, which will greatly mar the appearance of the model.

Obtain the sweepback angle with the leading spar first. Measure the sweepback as shown in Fig. 1. Lay a straightedge along one half of the spar, with a rule running from the straightedge at right angles; then cement the end of the second half of the spar to the end of the first in such a way that the outer end of the second half will extend from the straightedge a distance (measured on the rule) equal to twice the distance of the given sweepback. Now, if you place the center point of the spar on the straightedge and adjust the two ends of the spar so that they register

Fig. 6. Excess tissue can be trimmed from the wing with an old razor blade.



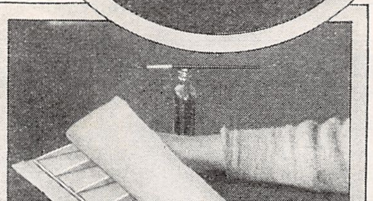


Fig. 7. In covering a wing, the bottom surface is completed before the top is started.

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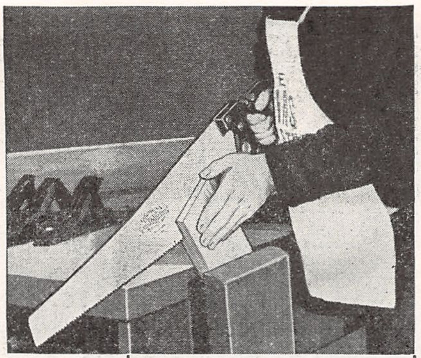

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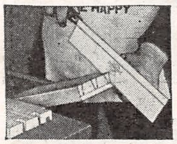

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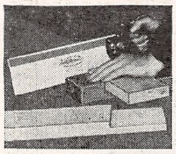

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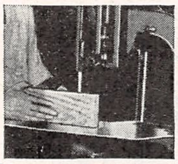

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an equal distance from the straightedge, this distance should be exactly the required sweepback.

The ribs are next cemented in place, and the trailing edge spars cemented to them. If the wing structure calls for wing tips, these should be attached. When the ribs, trailing edge, and tips have been cemented, the joint of the two wing halves should be broken, and the dihedral angle given the wing. Lay one side of the wing on a flat surface and raise the tip of the other side until it registers twice the distance of the given dihedral when measured with a rule held perpendicular to the surface as shown in Fig. 2. After the structure is thoroughly dry, test it again for proper dihedral and sweepback.

The wing is now ready to be covered. For convenience, the writer has shown this work in eight different steps, Figs. 3 to 10. As all tissue is usually wrinkled when bought, the builder should first iron it smooth (Fig. 3). If the wing is to have a double surface, the paper should be cut a little wider than twice the width of the wing (Fig. 4), but if it is to be covered on one side only, cut the paper slightly wider than the width of the wing. Only one side of the wing is covered at one time, and the paper is so cut as to allow it to lap over the tip, or end.

The third step is to apply clear dope to the underside of the wing along the leading and trailing edges, along its spars, if any, and on all edges of its ribs (Fig. 5).

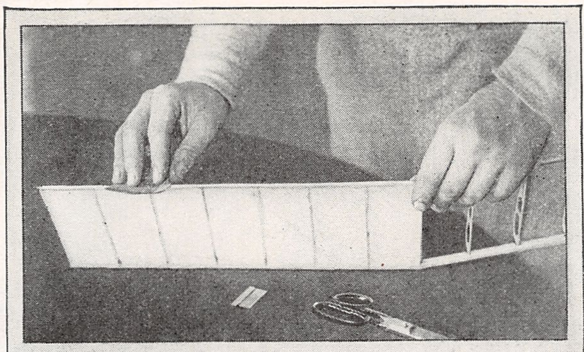
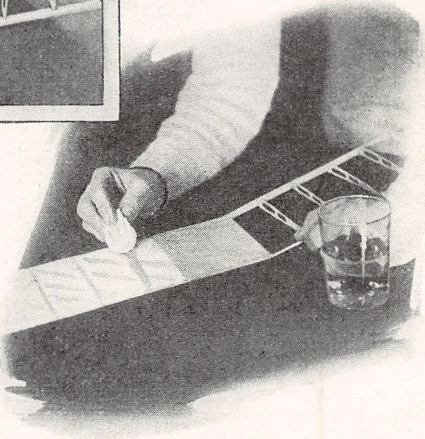


Fig. 8. A final trimming can be given the wing with sandpaper after the dope is dry.



Below: Fig. 9. Sprinkling the tissue with water will cause it to contract and tighten.

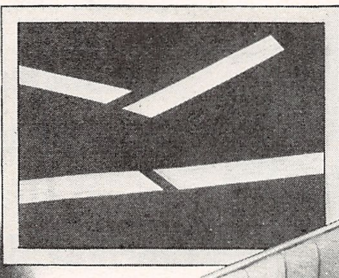


Fig. 11. A simple way to obtain the same angle on all the spars.

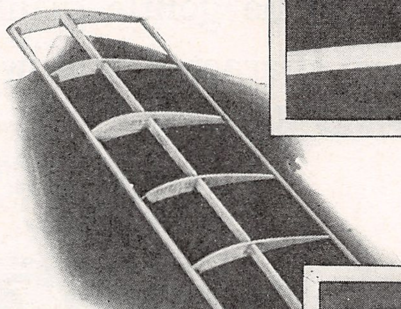


Fig. 12. A heavy rib may be placed where the wing is in contact with a strut. *Right:* Fig. 13. Three simple wings.

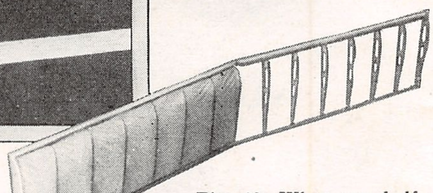
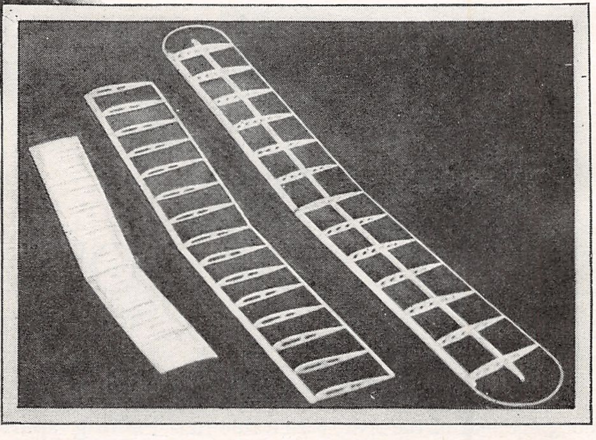


Fig. 10. When one half of the wing is completed, cover the other half.



The paper is now placed on a flat surface, and the wing laid on it while the ribs and spars are lightly pressed against the paper. Make sure that the paper adheres at all points along the wing.

When the bottom of the wing is covered, the top is likewise coated with dope, and the wing is rolled over on its leading edge and then on its top while the paper is smoothed and stretched on its upper side (see Fig. 7). The ends are turned over the last rib on each end and held in place with dope.

The excess paper is now trimmed. This can be done with an old razor blade (Fig. 6) or a small pair of nail scissors. When the dope is thoroughly dry, a small piece of sandpaper should be used to trim the

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

wing properly (Fig. 8). This removes the tissue from the spars and gives the appearance of neat, expert work.

The wing surfaces of light endurance models should not be doped. It will be found that sprinkling the tissue with plain water (Fig. 9) will tighten the surface and give an excellent appearance without adding any weight. On extremely light models where the wing is covered on one side only, even this water treatment should not be given, as the pull produced from shrinking will cause serious warping.

As for using dope on such surfaces, only a strong wing construction can withstand the pull from shrinking, and the builder must judge the strength of his wing carefully before attempting such a finish. If the wing is of the necessary strength to allow a coat of thin dope to be applied, the water treatment should be given first, as this will smooth out all creases and allow the builder to flow the dope on the surface much more easily.

WHEN the wing is finished, it should be carefully tested as shown in Figs. 1 and 2. Warping caused by covering and doping often throws the light frame out of line, and any errors must be corrected. In Fig. 10 the wing is shown after one half has been covered. Its other side is now covered in the same manner.

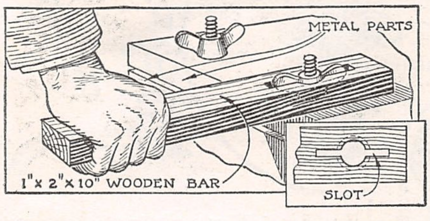
A simple way to obtain the same angle on all leading, trailing, and inner spars is to lay them together and cut through their centers at an angle, as indicated in Fig. 11. One cut is made through all spars at the same time; then one member of each pair is turned over as shown, and the parts are cemented together after being measured for correct dihedral or sweepback.

Where the wing must come in contact with a strut, a heavy rib may be inserted, as shown in Fig. 12 (the third rib from the end). This strengthens the structure at this point and insures it against breaking.

A few simple wing structures are shown in Fig. 13 as a guide to the novice. It must be remembered, however, that when constructing any part of a model airplane, no complete set of rules and regulations can be given to cover the work.

In his next article Mr. Hamilton will discuss fuselage construction.

WOODEN "WRENCH" TURNS STUBBORN WING NUTS



The writer found this wrench particularly useful in loosening pressure cooker nuts.

STUBBORN wing nuts on household appliances can be turned easily with the aid of a wooden "wrench" made as shown. The hole in the stick should be drilled and cut to fit snugly over the wing nut, and the corners at the handle end should be rounded.—W. H. Burrows.

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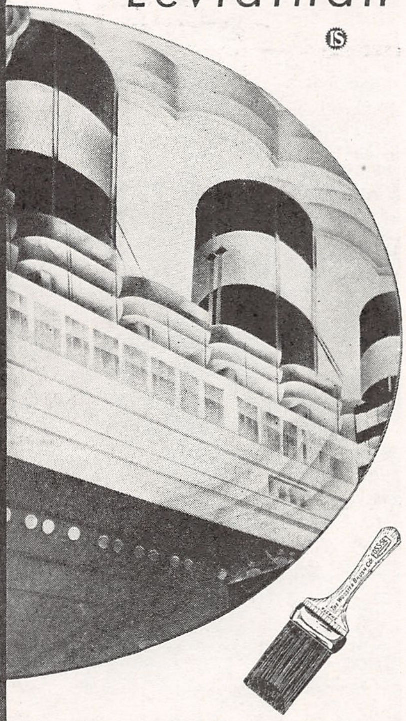

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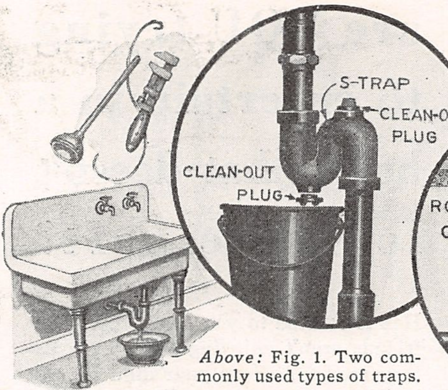
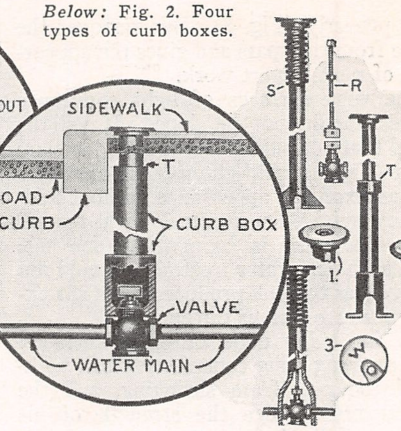


Above: Fig. 1. Two commonly used types of traps.

Below: Fig. 2. Four types of curb boxes.



Minor Plumbing Troubles *and how to* Overcome Them

THE old adage, "A stitch in time saves nine," can well be applied to the minor plumbing repairs about the house that generally go unnoticed until more evident—and generally more costly—difficulties arise. Small repairs take but little time to make, and serious trouble and much expense can often be averted if the home owner will do the job himself at the first sign of trouble. (See also P. S. M., Dec. '30, p. 132.)

What is the best method of cleaning out a clogged trap under a sink, tub, or basin?

If traps are given a periodic cleaning, they should not become clogged. When, however, there is a complete stoppage, attempt to clear the passage by the use of a plumber's rubber force cup or suction plunger. First, cover the bottom of the sink, tub, or basin with about 1 in. of water; then place the plunger over the drain outlet and work the handle up and down, thus forming a suction and pumping action inside the pipe and trap. Remove the plunger from over the drain after every three or four attempts and allow water to enter the pipe.

In stubborn cases, one of the various commercial drain cleaning solvents may be used. These are obtainable at hardware stores and often from grocers.

If these attempts fail, it will be necessary to clean the trap by means of a wire or a plumber's steel spring clean-out auger. Place a pail under the clean-out hole and remove the plug (Fig. 1). Prod around in both branches of the trap with a 3- or 4-ft. length of heavy wire bent to form a hook at the end, or screw in the flexible auger. Whichever tool you use, remove it from time to time to bring out the waste. When the pipe is clean, replace the plug and flush the drainpipe with water.

What is the chief value of the street valve and curb box from the house owner's viewpoint?

To shut off the water in a serious emergency, especially if a leak should develop between the street and house valves. It is advisable to make a personal inspection of the curb box periodically.

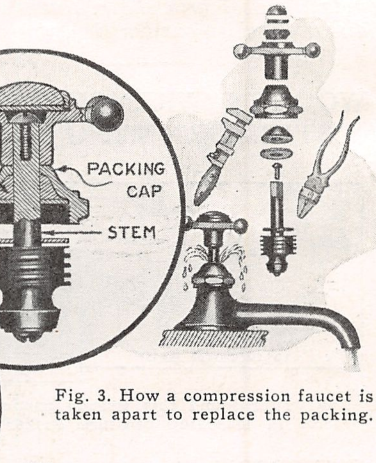


Fig. 3. How a compression faucet is taken apart to replace the packing.

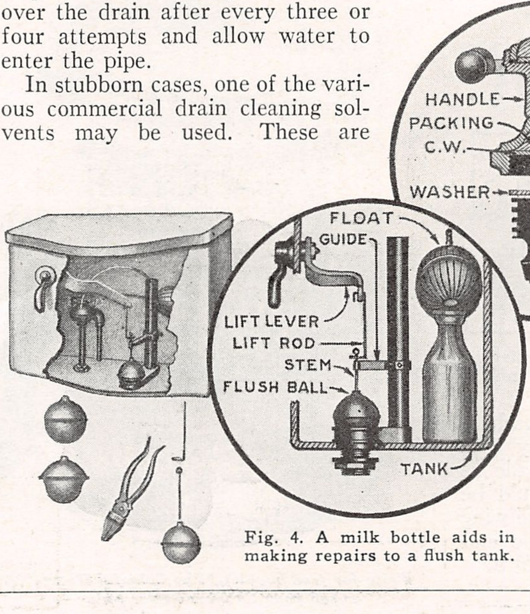


Fig. 4. A milk bottle aids in making repairs to a flush tank.

What can go wrong with a street valve and curb box?

Curb boxes come in four varieties, three known as the "saddle opening type" and the other as the "inclosed bottom" (Fig. 2). If the box is of the open-saddle type *S*, Fig. 2, it may shift away from the valve stem through the settling of the ground and make it impossible to reach the valve with the key. A periodic inspection will reveal this and make it possible to dig up the ground and replace the saddle over the valve. If the inclosed bottom type is used, little trouble of this sort is experienced since the box is screwed fast to the body of the valve. Inspection also will reveal if any dirt, stones, or sticks have fallen into the box and made it impossible to reach the valve stem. These can be removed with forked sticks or a looped snare made from heavy flexible wire. Be sure that the long key rod is where it can be found instantly.

If the valve sticks and all efforts to move it fail, what can be done?

A valve of this type never should be forced. If the valve tends to stick, pour a little kerosene over the stem and the top of the valve and give it time to penetrate; then apply an even pressure with the key.

How do you remove the top of a curb box?

There are three types of curb box tops in general use. That shown at *1* Fig. 2, has a center disk which is removable; *2* has a cap that unscrews from the top of the box; and *3* has a bolt which, when loosened, allows the cap to be swung to one side.

How can the packing on a compression faucet be replaced?

If water leaks from around the stem of a faucet when it is turned on, it is a sure indication that the packing about the stem has become worn and needs replacing. First shut off the water supply and open the faucet to relieve any pressure that may be present. Next, unscrew the packing cap from the base of the faucet (Fig. 3), remove the knurled nut that holds the "hot" or "cold" label in place, and remove the small screw that locks the handle on the stem. It is now a simple matter to remove the stem and the packing. A substitute for regular packing can be made by rubbing a little lard or soap on a piece of cotton twine about a foot long, cutting it into three pieces, and twisting the strands together. Replace the packing, put the cloth washer (marked *C. W.*) and the brass washer in place, and set the stem back in the packing cap. By screwing the packing cap back on the base of the faucet, you will bring the packing and washers into their correct positions.

Is it necessary to shut off the water supply when replacing the rubber ball valve in a flush tank?

No. the large float ball usually can be held in the off position by a milk bottle filled with water to prevent it from tipping (see Fig. 4). Then the replacing of the small rubber flush ball is merely a matter of unscrewing the stem, removing it from the guide, and putting a new stem and valve ball in place by a reverse process. Special rubber balls, which come in two shapes, can be purchased at any hardware store.—W. M. Butterfield.

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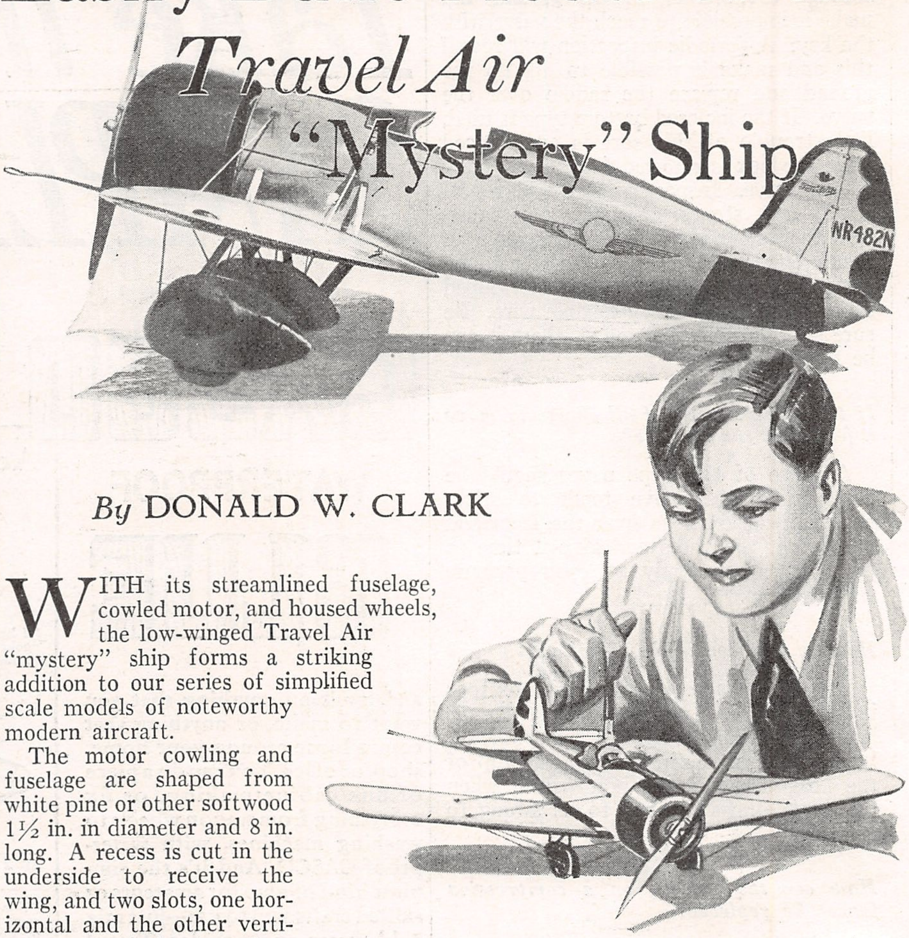


By DONALD W. CLARK

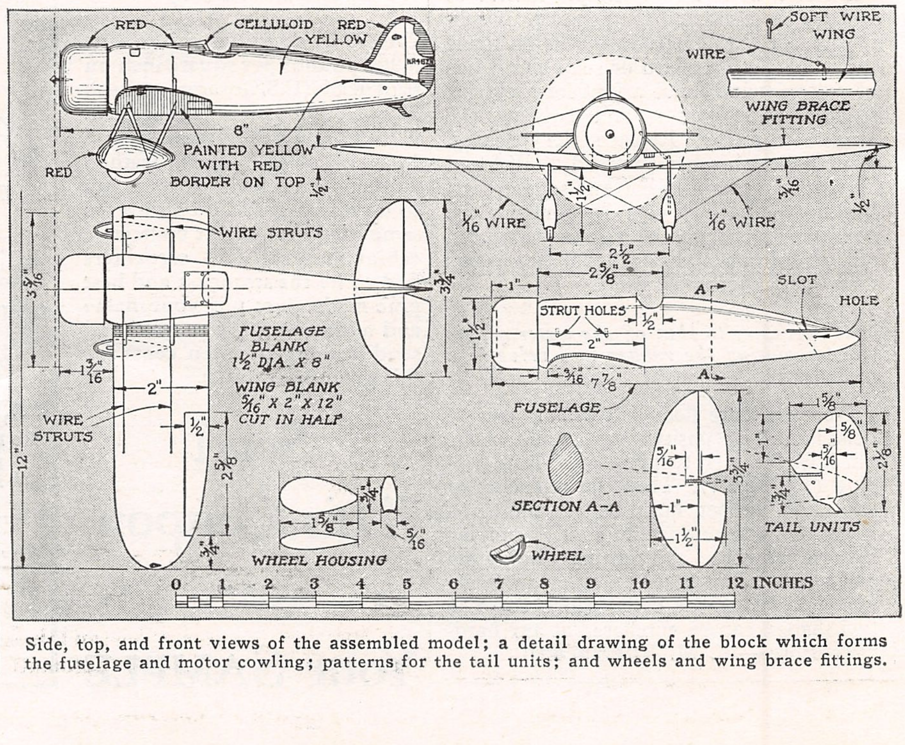
This plane has an especial appeal for model makers because it is of the type used in so many flights by Captain Hawks.

WITH its streamlined fuselage, cowled motor, and housed wheels, the low-winged Travel Air "mystery" ship forms a striking addition to our series of simplified scale models of noteworthy modern aircraft.

The motor cowling and fuselage are shaped from white pine or other softwood 1½ in. in diameter and 8 in. long. A recess is cut in the underside to receive the wing, and two slots, one horizontal and the other vertical, are made in the tail to receive the metal tail units.

Whittle the wing in one piece from a 5/16 by 2 by 12 in. piece of stock; then cut it in two so that each half can be given the proper dihedral before being fastened in place with brads.

Shape two streamlined wheel housings as shown. Then make one complete wheel, cut it in half, and glue each half to one of the covers. This will give you two complete wheels and covers. The tail units and the propeller are cut from thin sheet metal. Lollypop sticks may be used for the main struts; and the 1/16 in. diameter bracing wires are fastened to the wing as indicated.


RED
CELLULOID
RED
YELLOW
8"
RED
PAINTED YELLOW WITH RED BORDER ON TOP
½"
SOFT WIRE
WING
WIRE
WING BRACE FITTING
1/16" WIRE
1/16" WIRE
1½"
3/16"
½"
2½"
WIRE STRUTS
3 5/16"
3¾"
1 3/16"
2"
FUSELAGE BLANK 1½" DIA. X 8"
WING BLANK 5/16" X 2" X 12" CUT IN HALF
WIRE STRUTS
½"
2 5/8"
12"
¾"
2 5/8"
1"
A
SLOT
HOLE
STRUT HOLES
½"
1½"
2"
3/16
7 7/8"
A
FUSELAGE
SECTION A-A
3/4"
1 5/8"
5/16"
WHEEL HOUSING
WHEEL
5/16"
1"
1½"
3¾"
1 5/8"
5/8"
5/16
1"
2 1/8"
3/4"
TAIL UNITS
0 1 2 3 4 5 6 7 8 9 10 11 12 INCHES

Side, top, and front views of the assembled model; a detail drawing of the block which forms the fuselage and motor cowling; patterns for the tail units; and wheels and wing brace fittings.

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TO ASSIST you in your home workshop, Popular Science Monthly offers large blueprints containing working drawings of a number of well-tested projects. Each subject can be obtained for 25 cents with the exception of certain designs that require two or three sheets of blueprints and are accordingly 50 or 75 cents as noted below. The blueprints are each 15 by 22 in.

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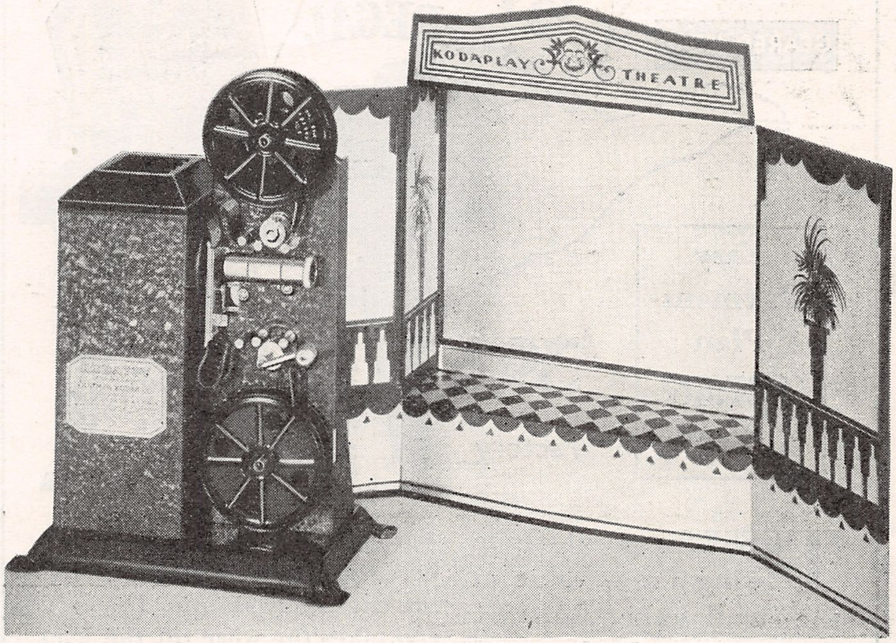

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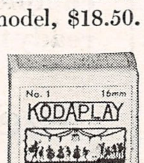

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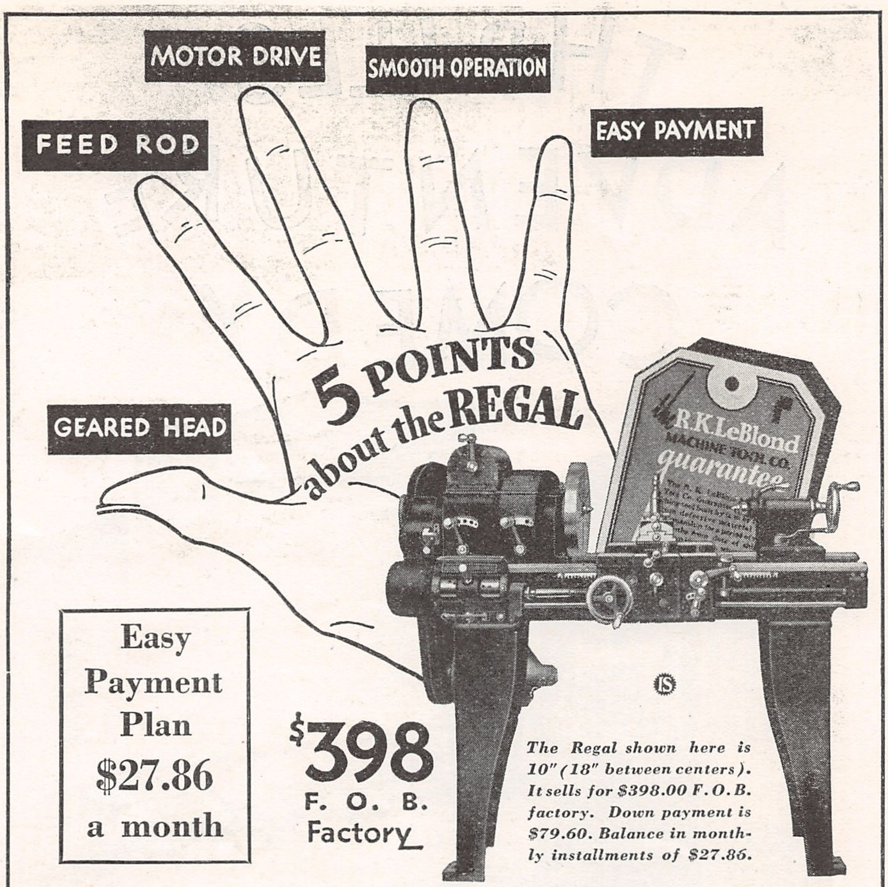

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An End Table That Strikes the Note of Modernism

By HERMAN HJORTH

WHETHER placed beside an armchair and used as an end table for magazines and books or set against a wall, the modernistic table illustrated in Figs. 1 and 2 is at once a convenient, attractive, and easily made piece of furniture.

First, obtain the stock from a lumber dealer according to the bill of materials on the following page. Remember, however, that the dimensions given are finished sizes and that a small allowance must be made for width (about ¼ in.) and for length (about ½ in.). Buy ⅞-in. stock dressed on both sides, and be sure to get boards that are dry, flat, and free from cracks or other defects. These boards may be obtained in any reasonable width and in suitable lengths. If the end table is to be stained, I should select a wood like gum, which has a beautiful grain and color and is easy to work. If it is to be painted or lacquered, a close-grained wood like whitewood is preferable.

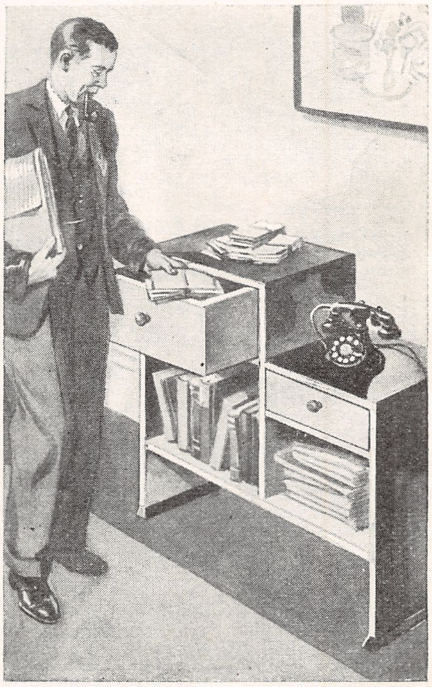


Fig. 1. Simplicity, angularity, straight lines, and clear, smooth surfaces distinguish this table.

All the boards should be sawed and planed to the exact lengths. Be careful to plane the ends of the boards true and square, otherwise a good joint cannot be obtained. The boards marked *A*, *B*, and *H* should be ½ in. longer than the finished dimensions given to facilitate the making of the joints on the end of each. See that boards *C* and *D* and boards *F* and *G* are exactly the same in length.

Smooth both surfaces on all the boards with plane, scraper, and sandpaper. Lay out all of the dadoes on all the boards, checking and rechecking the dimensions and placing corresponding boards side by side to see that the spaces between the dadoes are exactly alike.

A dado is a groove cut across a board into which the end of another board fits at right angles. Since this joint must be tight, it is well to place the end of the board that it is to fit into the dado on top of the lines to make sure that the dado is not marked too wide.

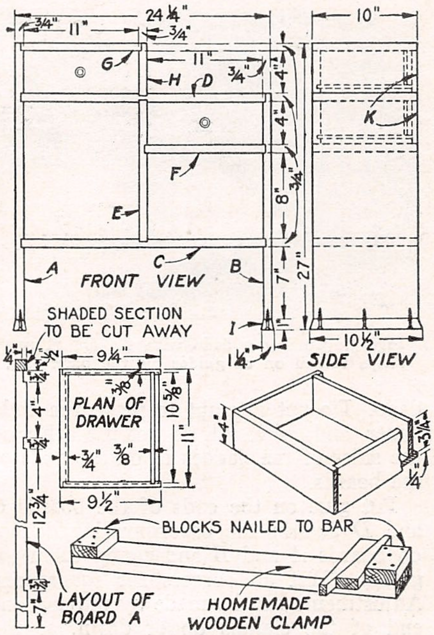


Fig. 2. Front and side views, details of drawers, layout for dadoes, and a homemade clamp.

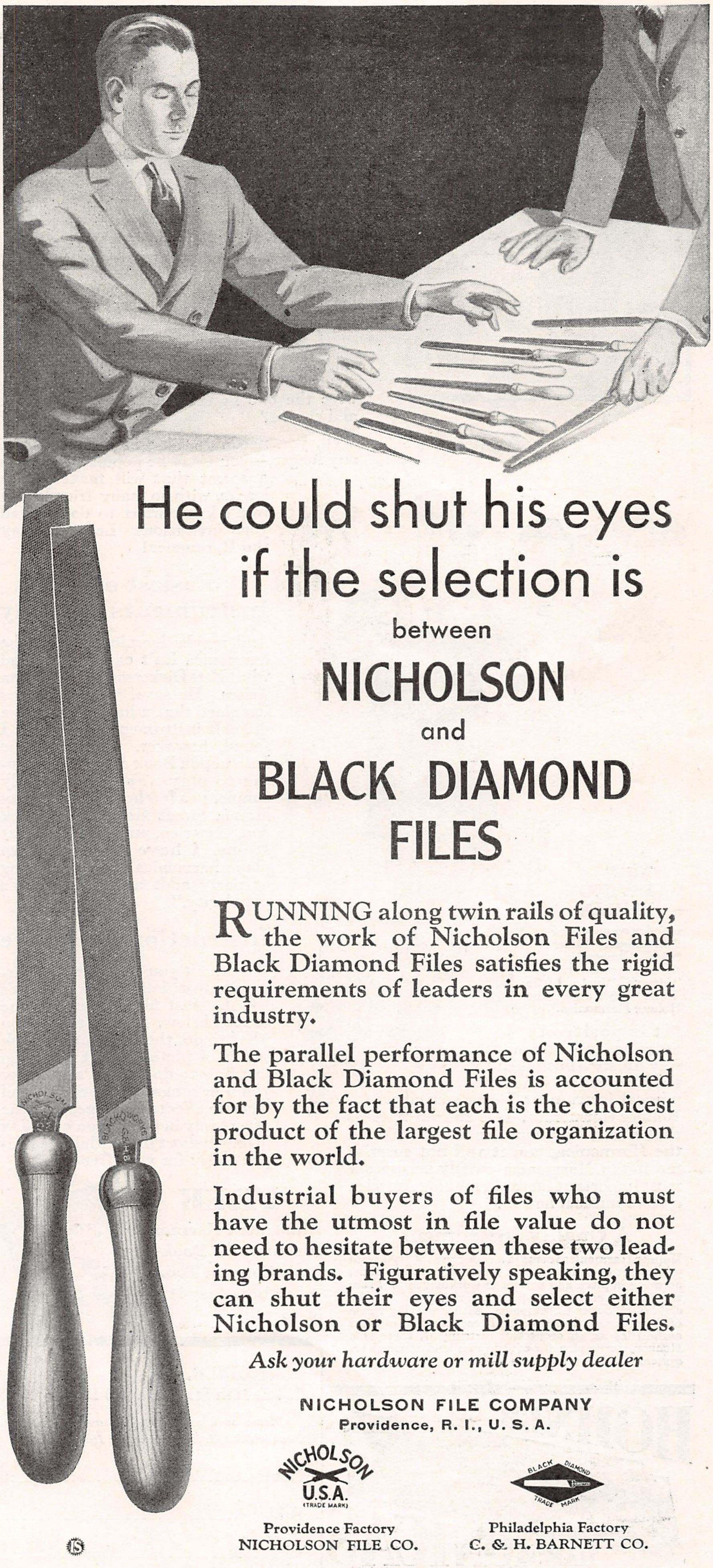
To cut the dadoes, a beginner can make the work easier by nailing a strip of wood on each side of the lines with fine brads. Saw down to a depth of 1/4 in. with a back saw as shown in Fig. 3, page 120. The strips of wood will guide the saw, insuring a straight cut just inside the lines.

Chisel down almost to the depth of the saw cuts, using a 1/2-in. chisel and a mallet. Hold the chisel with the bevel down, and cut from both edges toward the middle. Now adjust a router plane to the depth of the cut and plane all the dadoes with this setting of the plane (Fig. 4). Set the plane iron exactly to 1/4 in.

Materials for End Table

No. of Pcs.	Part	T.	W.	L.
1	Side *A*...........	3/4	10	26
1	Side *B*...........	3/4	10	21 1/4
2	Shelves *C* and *D*..	3/4	10	23 1/4
1	Partition *E*.......	3/4	10	13 1/4
2	Pieces *F* and *G*....	3/4	10	11 1/2
1	Side *H*...........	3/4	10	5
2	Feet *I*...........	1	1 1/4	10 1/2
2	Backs *K*.........	1/2	4	11
2	Drawer fronts....	3/4	4	11
4	Drawer sides......	3/8	4	9 1/4
2	Drawer backs.....	3/8	3 1/4	10 5/8
2	Drawer bottoms...	1/4	10 5/8	9
2	Drawer knobs			

All dimensions are in inches.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WHAT IRVING BERLIN popular composer of "All Alone," "Blue Skies", "Remember" "Russian Lullaby," "Always", "Just a Little While," says about the Hohner Harmonica.

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and again plane all the dadoes to insure an even depth.

Saw off the ½-in. projections on boards *A*, *B*, and *H*, leaving just a recess or rabbet on the upper ends (see Fig. 2).

Sand all inside surfaces to remove any scratches and fit boards *A*, *B*, *C*, and *D* together. If any of the dadoes should be too narrow, a little may be planed off the surface of the board that is to fit in the dado. Do not attempt to make the dado wider, and above all, do not use a file on the sides of the dadoes or on the ends of the boards.

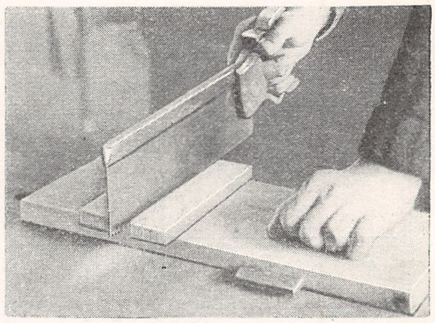


Fig. 3. Cutting a dado with the aid of two strips tacked on as guides for the back saw.

Put glue on the ends of the boards *C* and *D* and in the corresponding dadoes on boards *A* and *B* and clamp them together. Test all corners for squareness. Adjustments can be made by moving one end of the clamps up or down, as the case may be. Protect the finished surfaces with blocks. A homemade clamp such as shown in Fig. 2 can be made from odd pieces of lumber. Next fit pieces *E* and *F*, put glue on the ends and in the grooves, slide them in place; and then fit and glue boards *G* and *H*.

The glued boards may be reënforced with brads set below the surface of the wood, but this is not necessary when the joints fit tightly and the gluing is well done. When dry, all the edges should be smoothed with a plane and sandpaper. The feet are then made and screwed in place as shown in Fig. 2.

If drawers are to be fitted between the boards *D*, *F*, and *G*, the space in the rear should be filled with boards *K*, especially if the table is to stand free. Each drawer consists of a front board, which first should be fitted to the opening the drawer is to fill, and two sides, a back, and a bottom.

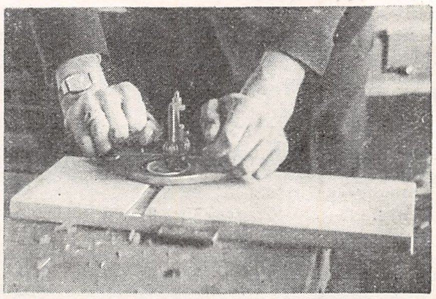


Fig. 4. After the dado has been roughed out with a chisel, it is finished with a router.

The front and the sides of the drawer all have a groove for the bottom. The front is rabbeted for the sides, and a dado is cut in each side for the back.

These grooves, rabbets, and dadoes may be made as explained above if a motor-driven groover or a grooving plane is not available. The sides of the drawer are glued and nailed to the front board, the back is then glued to the sides, and the bottom is slid into the grooves and nailed to the underside of the back.

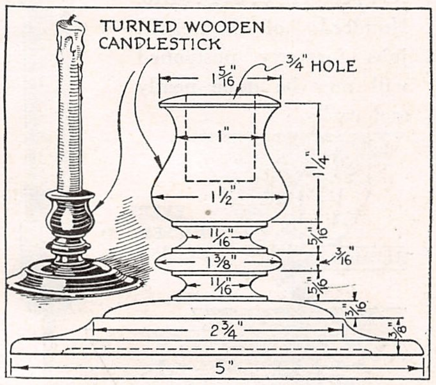
As to the finish, the following procedure is recommended: If made of gumwood, no stain is needed unless a darker shade is desired. A coat of white or orange shellac, thinned with alcohol, is first applied. After a few hours this is rubbed down with No. 00 steel wool, and another coat of shellac is applied. This also is rubbed with steel wool, after which the table may be finished with a coat of wax, either liquid or paste. Instead of being shellacked and waxed, the edges and the feet may be given one or two coats of black lacquer. This will hide the joints and at the same time will also make a pleasant contrast.

If an opaque finish is desired, the piece should be given first a coat of thin shellac. After being rubbed down, this should be followed by one or two coats of colored lacquer. Again it is desirable to finish the edges in a contrasting color.

WOODEN CANDLESTICKS OF MODERN DESIGN

THIS low decorative candlestick is of the modern type. With the tall graceful candles now so popular, it looks better than the more usual type of candleholder.

A pair of the candlesticks may be made of mahogany, gumwood, or walnut. In turning them the chief point to remember is to make them appear as "squatty" as possible.



A pair of candlesticks turned to this design will ornament any console table or mantel.

Stain them the desired shade and fill the grain of the wood with a good paste wood filler of the same color. Apply a coat of high-grade varnish, allow it to dry at least two days, and then rub the candlesticks down with pumice stone and oil. The rubbing should be done on the lathe. After clearing off every trace of pumice stone and oil, give them another coat of varnish. Rub first with pumice stone and then with rottenstone to give a final luster.

The protruding ends or centers, which I make a practice to retain until the end, are now cut off, and a 3/4-in. hole is bored in the top.—Richard Graves.

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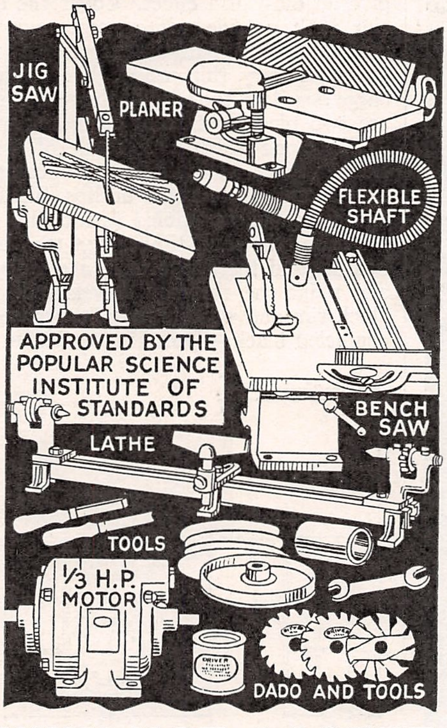

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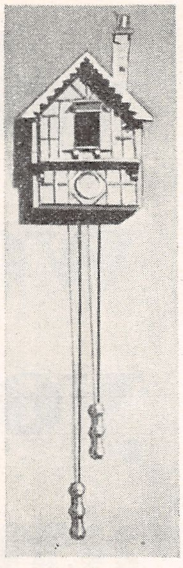
BIRD HOUSE RESEMBLES A CUCKOO CLOCK



The bird house.

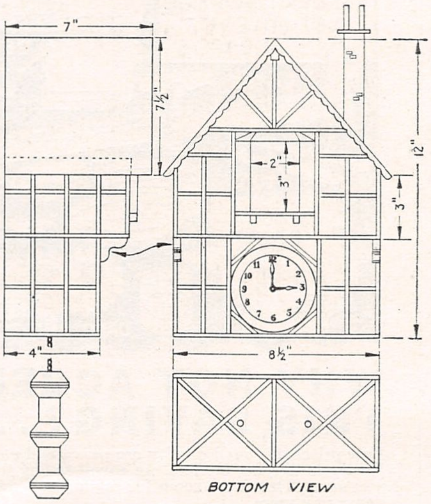
QUAINT as a cuckoo clock, this bird house will provide many amusing moments for children and adults alike, if it is hung at a gable end of house or garage.

The house can be built of odds and ends of light boxes or any planed ¼-in. material, together with a discarded small clock, two yards of cheap chain, and six empty spools. While the drawings give dimensions, they are the maximum for this type of bird house, and it can be built much smaller for wrens and other little birds. The doorway, which is 2 by 3 in., may be modified to exclude undesirable birds by closing it from the inside with a piece of ⅛-in. board in which a hole has been bored.

The chimney is merely a piece of blind stop surmounted by two small dowels to give an old-world effect. Cover the exterior with outside white paint and then reproduce the half-timber design with strips of very thin wood. The scalloped barge boards at the edge of the roof cornice are two pieces cut from cigar box wood.

The clock weights are made of spools. Each weight consists of two complete spools and two flanges or lips cut from another spool, assembled as shown.

Finish the half-timbering, the barge boards, and the supports in a dark stain, and paint the chimney dowels red. The clock rim and weights may be bronzed or enameled black.—DON HOUSEWORTH.



Side, front, and bottom views of the cuckoo clock bird house with suggested dimensions.

ONE who has not used masking tape in decorating with lacquer has neglected one of the best aides in such work. Such tape is indispensable for striping with the brush and for shading with the spray gun. It sticks anywhere, yet can be peeled off without leaving any residue of gum or paper.—C. E. LIBBY.

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GO!— Go the *man's* way, on the *man's* steed—an Indian Motocycle. Leave the glass enclosures for your wheel-chair days. Now, while your blood runs and your heart sings, put *thrill* in your goings—ride a lean, lithe motorcycle.

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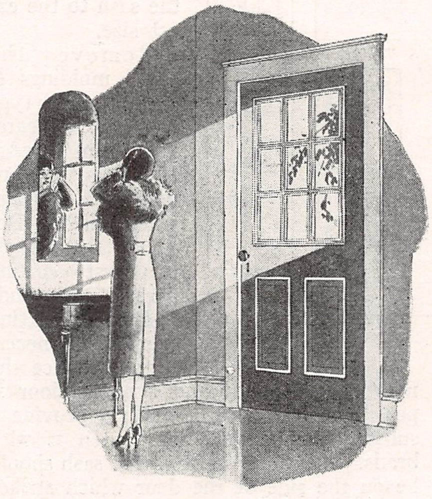
Altering Doors to Get More Light

SOLID, paneled outside doors, which keep out the sunlight and often give the appearance of being excessively heavy, can be easily altered by substituting a sash and glass lights for two or more of the wooden panels.

The average door of this type is generally from 1¼ to 2 in. thick, but the methods to be described can be applied to a door of any thickness. The first step is to examine the construction of the door and determine upon the method to be used in fitting the sash to it. It is obvious that if a sash 1¼ in. thick is fitted into a 1½ in. door as at *A*, *B*, and *C* in the drawing at the bottom of the following page, it will project inside, but the same sash will fit nicely in a 1¾-in. door as at *D*. The sash may be made at a mill, in which case a common sash molding will be used, but we shall assume that the reader wishes to do the entire job himself, especially if he has a motor-driven workshop. Many types of moldings can be made, but the home worker can do no better than to use one with a bevel molding such as will be described.

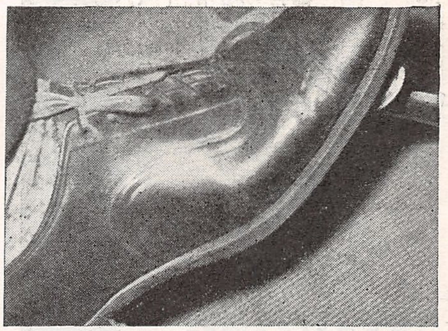


A sash and lights can be easily substituted for the panels of solid, old-fashioned doors.

The sash should be made of straight, well-seasoned white pine, whitewood, or redwood. Cut the stiles (upright members) *E* at least 1 in. longer than needed, the top rail *F* 1½ in. wide, and the bottom rail *G* 2 in. wide. A sash thinner than 1¼ in. will not stand the usage it will receive, nor will one large light of glass be so likely to resist the slamming of the door as will the smaller lights suggested.

The middle rails *H* and the muntins *J* should be ¾ by 1¼ in. and the rabbets *K* a scant ¼ by ½ in. to allow ⁵⁄₁₆ in. between them as shown. The rabbets on the stiles and rails should be the same. The flat face *L* and the bevel *M* should be planed by hand, care being taken to see that, in all cases, the corner *N* is squarely opposite the corner *K1*, which will bring the distances *O* on *H* and *J* equal.

Lay the pieces close together in their correct relation and mark across all at



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If anyone accused you of running your motor without oil for at least three minutes a day, you'd certainly deny it.

But, as a matter of fact, you're probably doing that very thing—and your engine is suffering accordingly.

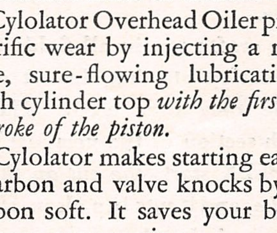
Every time you step on the starter three minutes elapse before crankcase oil works up to your cylinder tops. During this time pistons grind cylinder walls—metal against metal—with no lubrication whatsoever. Your motor receives wear equal to over a hundred miles of normal driving.

The Cylolator Overhead Oiler prevents this terrific wear by injecting a mist of effective, sure-flowing lubricating oil into each cylinder top *with the first downward stroke of the piston.*

The Cylolator makes starting easier. It stops carbon and valve knocks by keeping carbon soft. It saves your batteries—improves compression.

The Cylolator is attractive in design and durable in construction. Its oil bowl is protected by a chrome-plated case. All metal used in the Cylolator is highly resistant to corrosion.

The Cylolator costs but $15.00 complete. We will gladly send you a booklet which explains by text and diagram the working principle of the Cylolator. Address Motor Improvements, Inc., 357 Frelinghuysen Ave., Newark, N. J.



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In addition to fast, clean cutting of regular work, the MILFORD DUPLEX cuts small sections, squares, angles or flat stock with equal accuracy *at any angle.*

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Mil Flex DUPLEX (Hard Teeth-Flexible Back)

Made in 14/28-pitch and 18/36-pitch. The fine teeth start the cut like the feed screw of an auger bit.

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PATENTED U.S.A.
The HENRY G. THOMPSON & SON CO.
Established 1876
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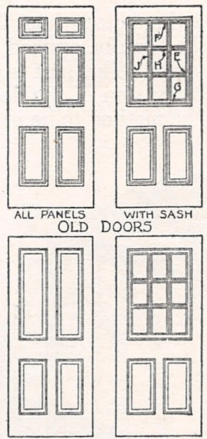
once with a knife to locate the mortises *P,* tenons *Q,* shoulders *R,* and face corner *N.* Cut the rails to exact length and fit *P, Q, R,* and *N1* of each joint. Make the coped (shaped) joints *S* on the top and bottom rails. Try the sash together dry to check for errors. Sandpaper all exposed surfaces of the molding and glue the sash together, being sure that it is perfectly square. When the glue has set, bore 3/8-in. holes through the stiles and into the rails for about 1½ in. and fit dowels as at *T.* Smooth and sandpaper both sides of the sash, saw the ends of the stile flush, and plane the edges of the sash to the exact size.

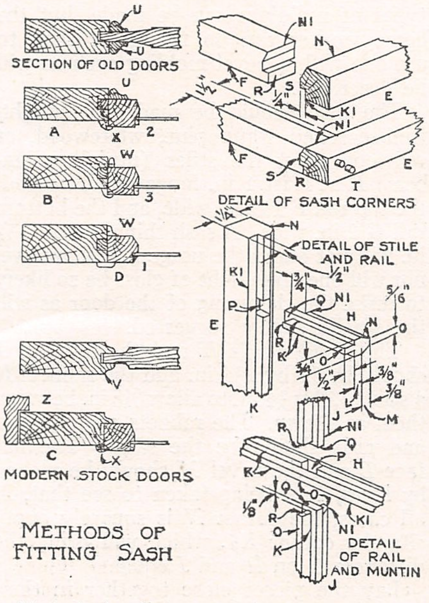

ALL PANELS
WITH SASH
OLD DOORS
ALL PANELS
WITH SASH
STOCK DOORS
P
S
H
F
G

Any type door may be altered in this way.

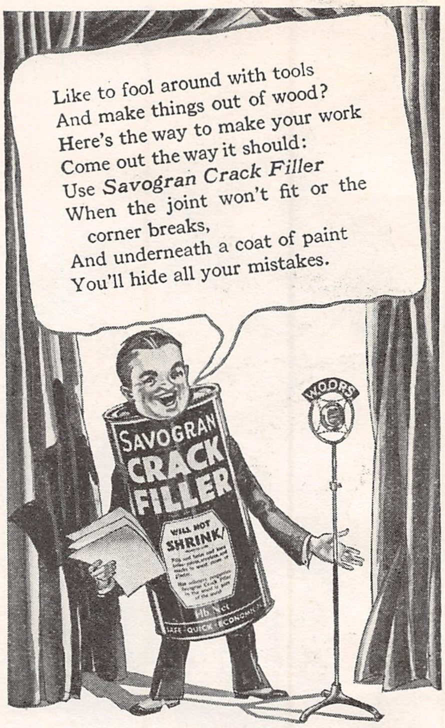
Remove the panel moldings *U* from the old type of door, or carefully trim to edge *V* on a modern door with a sharp, wide chisel. Remove the panels by first cutting across the ends and then splitting them out if necessary. Replace the moldings *U* on an old type of door if possible; if too badly broken, provide a substitute as at *W,* and fasten it with brads. The molded side of the sash should be on the side of the door which strikes the rabbet of the jamb as at *Z.*

Fit the sash in place, fasten it temporarily, and fit molding *X.* Remove the sash and set the glass with glazier's points and putty, if desired, as at *1.* There will be less danger of breaking glass, however, if it is held in place with a ¼ by 3/8 in. stop as at *2,* cut in square; or with a bead (a strip with a rounded edge) as at *3,* mitered at the corners.

Fasten the sash permanently and paint, being sure that all joints are well filled to resist dampness.—CHARLES A. KING.


SECTION OF OLD DOORS
U
A
X
2
W
B
3
D
1
V
Z
C
X
MODERN STOCK DOORS
METHODS OF FITTING SASH
N1
N
F
R
S
1½"
¼"
K1
E
T
DETAIL OF SASH CORNERS
¼"
DETAIL OF STILE AND RAIL
½"
¾"
Q
P
H
O
5/6"
K
3/8"
L
M
J
DETAIL OF RAIL AND MUNTIN
1/8"

Methods for fitting sash in place, and how the rails and muntins are shaped and fitted.


Like to fool around with tools
And make things out of wood?
Here's the way to make your work
Come out the way it should:
Use Savogran Crack Filler
When the joint won't fit or the
corner breaks,
And underneath a coat of paint
You'll hide all your mistakes.
WOOPS
SAVOGRAN CRACK FILLER
WILL NOT SHRINK!

HOWDY, folks! Station WOOPS sounding off over the National Crackwork. Here's good news for handy men, "Mr. Fixits," model makers, and toy builders. Yessir! Don't get discouraged when you make mistakes. Just mix up a little Savogran Crack Filler, press into place, smooth off, and go on with the job. When you paint it nobody can detect the repair, because Savogran Crack Filler *will not shrink*—and it doesn't ring or show through the paint. It stays put. Works like wood—can be sawed, cut, smoothed—holds nails and screws firmly. Sure is easy to use—hard to get along without after you once use it. And it comes in mighty handy for fixing loose castors, mending furniture, and hundreds of other repair jobs.

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Get a big 1-lb. can today at your hardware or paint store—only 30c. Bigger sizes if you want them (5-lb. can, $1.25; 35-lb. pressed-steel pail, $7.70). Ask also for Painters' Savogran—saves hard work on painting jobs and heavy cleaning. And write for the popular free booklet, "How to Repair and Refinish Furniture." It's mighty helpful.

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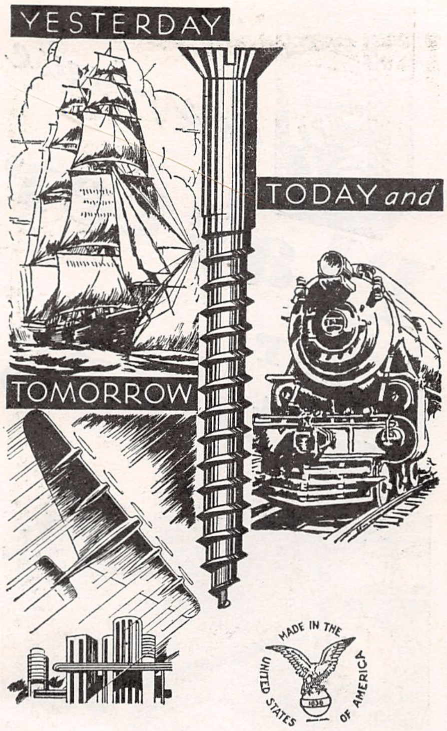
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FOR many generations and in many countries, American Screws have played an important part in building and repair work. It is safe to say that the same will be true in the future, because the name American Screw Company stands for quality in screws of all types for all purposes.

Our reputation is an "insurance policy"—it insures you against inferior screws.

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WESTERN DEPOT, 225 WEST RANDOLPH ST., CHICAGO, ILL.
"Put It Together With Screws"

IS NEW RUSSIA, BUILT BY AMERICANS, A WORLD MENACE?

(Continued from page 22)

and steel center outside the United States.

At Cheliabinsk, also in the Urals, they are building the world's largest tractor plant.

At Azbest, in Siberia, a New York engineer, almost alone, is developing a thirty-six-mile asbestos deposit, containing 12,000,000 tons of the valuable mineral.

These five man-sized jobs are among the main props of the Five-Year Plan. If they succeed, the plan will work. If they fail, the whole scheme will blow up. There seems to be little chance of failure. Progress already made on some of them indicates that it will take only four years, instead of five, to complete them.

BESIDES, the American engineers are opening mines, taming rivers, drilling oil wells, tunneling mountains, bridging streams, cutting roadbeds, erecting and equipping power plants, and building and putting into operation factories of all kinds all over Russia.

They are doing this in a country as large as the entire North American continent which, under the Czar, had fewer factories than the state of Pennsylvania, and those few old-fashioned and small. In 1921, as a result of revolution, civil war, and famine, these factories were producing only seventeen percent of their pre-war output.

American engineers and American machinery got to Russia in 1928. Last June, when they had been there two years, production had climbed to 180 percent of that of 1913, or more than ten times that of 1921!

This is the prospect in which economists find disturbing factors. Can this great development be kept within bounds, or will it break out by its own right to bring havoc and ruin to all Europe and possibly America? Few at present are daring enough to answer these questions.

Today the Five-Year Plan looks like a success, though the final success of the communist government is still doubtful. It is true that the land has been nationalized, that virtually all trade is in the hands of the state. But all progress in industry has been won by means of hated capitalist methods and with capitalist machinery and brains.

Until recently, the railroads were a flock of flies in the industrial ointment. From the Czar's regime the Soviet took the largest and poorest managed railroad system under one control in the world. It consisted of 60,000 miles of run-down track, 17,000 largely dilapidated locomotives, more than 1,000,000 employees and no service to speak of. In miserable shape, the system broke down completely under the strain of the feverish activity of the last two years.

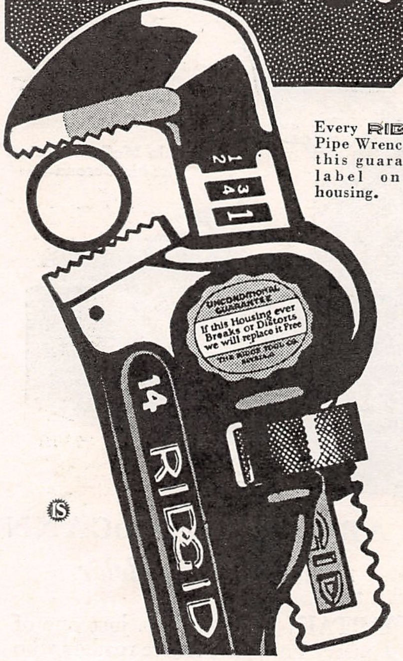
AGAIN, the Soviet called in an American expert to set things to rights. A few weeks ago, Charles A. Gill, superintendent of motive power of the Baltimore and Ohio Railroad, sailed for Russia to reorganize the system and operate it according to American methods. He will be gone one year.

In that time, he will spend $900,000,000 of the Soviet's money for increased tracks, new equipment, plants, and repairs. Under him will work a force of 150 American railroad men, including specialists in every line, from superintendents and shop foremen to trainmasters and signal men.

Among the projects now being directed by Americans is the giant hydroelectric power dam in the River Dnieper, at Kichkas, in the Ukraine, 200 miles from Odessa. There, Col. Hugh L. Cooper, builder of the Wilson Dam at Muscle Shoals and chief engineer of the Niagara

(Continued on page 126)

YOU CAN'T BREAK THE HOUSING!


1/2
3/4
1
UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO.
14
RIDGID
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Every RIDGID Pipe Wrench has this guarantee label on the housing.

IF YOU want a pipe wrench to stand punishment, buy a RIDGID. You can't warp or break the housing—even if you bend pipe with it. No more bother with broken housings or the expense of repairing them.

You get also a *replaceable heel jaw;* full floating hook jaw, *with pipe scale;* adjusting nut that turns easily in wide open housing; comfortable, stout I-beam handle with hang-up hole. And others.

Get just one RIDGID at your Hardware Store or Jobber's and enjoy a new pipe wrench experience. We'll send you a regular 6" RIDGID for 20¢, as a sample to show you the remarkable RIDGID design. Use the coupon.

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Memo to The Ridge Tool Co., Elyria, Ohio
Please send me sample 6" RIDGID Wrench, 20¢ enclosed.

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Captain McCann seated
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IS NEW RUSSIA, BUILT BY AMERICANS, A WORLD MENACE?

(Continued from page 125)

power development, is doing the biggest job of his career. With a staff of five American engineers and an army of 17,000 workmen, he is constructing a plant that will eclipse those at Muscle Shoals and Niagara.

Imagine one power plant supplying electric energy to an area as large as the six New England states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, and Rhode Island put together, and you have an idea of the size of this job. When completed, it will furnish 2,500,000,000 kilowatt hours of energy a year to a territory of 70,000 square miles. The Soviet says that in time this will be a teeming industrial section with a population of 8,000,000. At present, only 1,000,000 people are living there. But a new city, to house 500,000, first of a string of modern factory towns, is rising on the river bank.

THE plant will increase Russia's power output five-fold, putting it in third place, instead of tenth, among power producing nations, with only the United States and Germany ahead of it. The dam will be one and a quarter miles long, 200 feet high, and will contain 1,150,000 cubic yards of concrete. There will be a power house 820 feet long, with nine turbines of 85,000 horsepower each and an ultimate combined capacity of 850,000 horsepower. Muscle Shoals produces 620,000 horsepower. The turbines, built by the Newport News Shipbuilding and Drydock Co., are the largest in the world. Those at Niagara, generating 75,000 horsepower each, come next.

The great dam, as a navigation project, was planned as early as the second half of the eighteenth century, in the reign of Empress Catherine the Great. Afterwards it was taken up under several of the Czars, but nothing ever came of it.

It was left for the Soviet, aided by American engineering ability, to make a real start. Half of the huge job on the Dnieper now is finished. Working at top speed in five-day, nonstop weeks, the 17,000 men so far have placed more concrete than was ever cast in a similar period in the history of engineering. With 114,400 cubic yards placed in one month, the men under Colonel Cooper's command last September smashed the Muscle Shoals record of 68,900 cubic yards placed in one month. Since then, they have bettered their own record. In October and November they placed more than 144,000 cubic yards per month.

THE vast majority of these 17,000 men, of course, are Russians. It is a safe bet that not 100 among them ever heard of Muscle Shoals. They were not out to break the record of the American workmen and set up a new world's record in concrete placing.

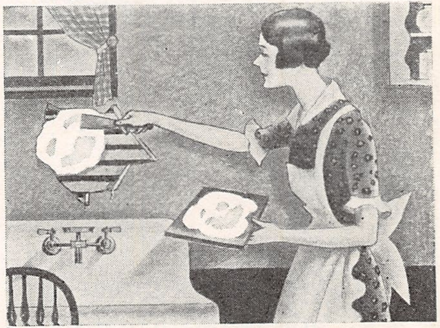
Colonel Cooper and his staff know how to get work done. But if you think that would be sufficient to make Ivan Ivanovitch, the average Russian, the "John Jones" of Russia, throw off his indolence, you don't know Ivan. At the Dnieper dam, as on all other big jobs now under way in Russia, he is plugging away for dear life for reasons of his own.

What are these reasons? Why this sudden energy and zeal? Wages in Russia are low. A skilled workman makes an average of about $42 a month; an unskilled man gets only $32. As nearly all wheat, meat, butter, and eggs are shipped out of the country, food is scarce, poor, and expensive. A pound of bad butter in Moscow today costs from $1.50 to $2;

(Continued on page 127)

RUTLAND PATCHING PLASTER
Just add water and use

Easy-to-use
Plaster for patching



Rutland Patching Plaster makes it easy to patch that crack or hole in wall or ceiling yourself. Just add water, then apply. Doesn't set fast like plaster of paris. Gives you time to smooth it in place. Permanent. Won't shrink, crack, swell or fall out. Takes paint or wallpaper perfectly; won't show through. At paint or hardware stores. Made by Rutland Fire Clay Co., Rutland, Vt.

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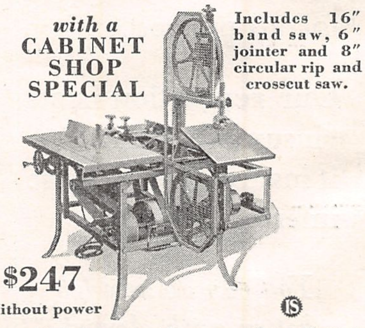
Includes 16" band saw, 6" jointer and 8" circular rip and crosscut saw.



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Nobody gets rich on a salary. Open a shop of your own and reap *all* the profits for your labor. *Write today for our complete catalog.*
Note: A circular describing the Parks "Producto" Electrical Home Work Shop and line of bench woodworking machines will also be sent you on request.

The Parks Woodworking Machine Co.
Dept. PS-4, 1525 Knowlton St., Cincinnati, Ohio
Good woodworking machines since 1887.
Canadian Factory: 338 Notre Dame East, Montreal.

PARKS
WOODWORKING MACHINES

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

IS NEW RUSSIA, BUILT BY AMERICANS, A WORLD MENACE?

(Continued from page 126)

a pound of tough beef costs about $1.50.

The great mass of the people live on black bread, the only food that is plentiful, fish, and vegetables.

Since all business is in the hands of the state and the government imports nothing but machines, clothes are hard to get, and shoes are at a premium. Despite all this, the average Russian workman last year did half again as much work as he did in 1913, under the Czar. What is the secret?

We, in the United States, often are accused of chasing the almighty dollar. Most of us do nothing of the kind. What we seek is security. Human nature in Russia essentially is the same thing as in America and anywhere else. The Soviet leaders seem to be thoroughly aware of this human trait and so, to begin with, they have given Ivan security. True, he only makes, say, $42 a month. But he is taught that he will get a government pension when he is too old to work. When out of a job, he receives unemployment insurance. As a matter of fact, instead of unemployment, Russia today has an actual labor shortage.

When Ivan is sick, he gets free medical treatment. When his wife has a baby, she is taken care of, free of charge, at a government hospital. Each year he gets two weeks vacation with pay. If he works in a mine, or at an extra hazardous job, he is given a month's vacation. He has a day off every five days. He never works more than seven or eight hours a day.

In case of serious illness, or as a reward for extra effort, he is sent, at government expense, to the "Red Riviera"—Yalta, in the Crimea, a wonderful country with a climate like southern France, where he lives and plays in the old palaces of the Czars and the nobility, now changed into workingmen's hotels, clubs, and sanitaria.

These benefits amount to about twenty-seven percent of Ivan's wages. But his pay itself, low as it is when you judge it by American standards, is sixteen percent higher than it was before the war. In other words, Ivan not only has stopped worrying about the future, but he actually is better off today than he ever was.

Ivan's privations are serious only when looked at with American eyes. It is true that black bread is his main dish for breakfast, lunch, and dinner. It is true that there are tens of thousands of children in Russia who never have seen a piece of candy, and that the vast majority of girls and women don't know what it is to wear silk stockings. But don't forget that Ivan, his wife, and children never had luxuries, or even comforts. All the bacon and eggs are sent out of the country, but Ivan never had bacon and eggs. He never at any time had much more than his black bread. The difference is that now he gets it regularly—two pounds a day, as long as he works.

The Soviet has given Ivan more than security. It has given him more freedom than he ever dreamed of. It has given back to him his beloved vodka, which the Czar took away during the war. It has changed the marriage and divorce laws to suit his temperament. Today he can get married merely by taking his sweetheart to a government registry office. If that is too much trouble, a common law marriage is just as legal.

When either he or his wife wants a divorce, all that is necessary is for one or both to go to a government *(Continued on page 128)*

Profit by the Experience of these Men

Every year thousands of men buy bench machinery for the first time. Some follow their own judgment and regret the style of machinery they buy. Others profit by the experience of men who have **made a life-time study of bench machinery exclusively** and buy BOICE-CRANE equipment. There is not a thing in the BOICE-CRANE line that isn't there for a good, substantial and practical reason. You can't go wrong on BOICE-CRANE. These engineers guarantee that.

William B. Boice
Graduate electrical engineer. He sees that BOICE-CRANE machines are carefully built.

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Graduate Engineer
Specializes in precision machinery

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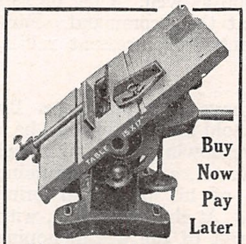
Graduate mechanical engineer. He is a designer, and specializes on shop layouts.



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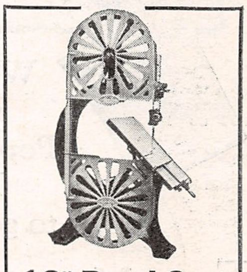
Universal Handisaw $30
Wonderful value. Will rip, grind, dado, bore, mitre, rabbet, joint, sand and mortise.

New Plan—Shop Pays for Self

Demonstrating shops needed in hundreds of towns. Your territory may be open. Get details. Here are high spots of plan. **1st—** You order in regular way. Send usual deposit. We ship machines and give you demonstrating franchise. **2d—** We send men to your shop who want to buy. You demonstrate. We do the selling. **3d—** You get commissions on all sales to prospects to whom you demonstrate. Makes it easy for you to meet payments. After all payments are made, you still get commissions. In your letter to us be sure state whether you want details of this plan.



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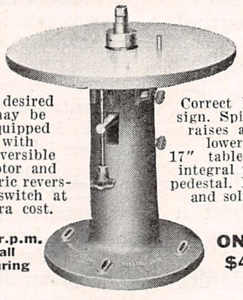

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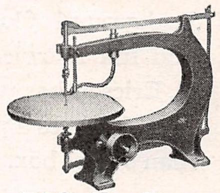
Correct Design. Spindle raises and lowers. 17" table cast integral with pedestal. Rigid and solid.
7000r.p.m. Ball Bearing
ONLY $49



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Large, massive and heavy. 20" capacity. Glutton for work. 15" dia. tilting table. Has improved hold-down shoe with blower. Blades swing to any angle. Weighs 70 pounds. Also 10" model priced at $12.00.

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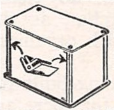

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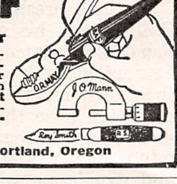

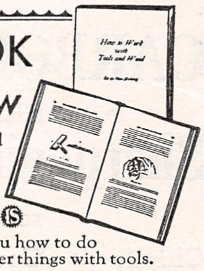
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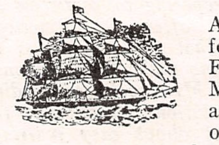

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IS NEW RUSSIA, BUILT BY AMERICANS, A WORLD MENACE?

(Continued from page 127)

bureau, and immediately the union is dissolved. No grounds are required. The only restriction is that the father must take care of his children.

The communist leaders have inspired Ivan with their own fanatic zeal for the "cause." They have made him feel that he no longer works only for himself and his family, but for the common good as well. They do this with every means at their command. Russia today is a country of incessant rallies, meetings, parades.

FINALLY, they have given him hope. By 1933, they have told him, Russia will be a land of plenty, overflowing with milk and honey. Ivan believes it, and he is straining with every ounce of his power to bring about this paradise. At the same time, with his eyes upon the rest of the world, hoping to thrust his regime upon other nations, he views himself as a crusader.

These are the main reasons for the new amazing display of energy. These are the incentives of the army of men now working day and night to complete "Russia's Detroit," fifteen miles from the old city of Nijny Novgorod, in central Russia, east of Moscow. Half a year ago, a handful of peasants lived on the site. Today, 10,000 men are erecting the great Soviet automobile assembly plant and the "first model communist city."

American engineers are in charge of this giant job. Nineteen engineers of the Austin Company, of Cleveland and New York, are directing the work of building the factory and the new town. Foundations for the plant, which will be 2,000 feet long, one of the longest buildings in the world, have been laid. Several of the apartment blocks in the model city are finished.

The model city, scheduled to be ready for 25,000 by the end of this year, will include up-to-date dwelling blocks, parks, schools, hospitals, clinics, restaurants, communal kitchens, libraries, theaters and a "palace of culture." One of the striking features of the city lies in the fact that the apartment houses will be planned so that children on their way to school will cross no traffic lanes. There will be no churches, as the Soviet government aims to abolish organized religion.

This remarkable city is not being built for the wealthy and their children, for there are no wealthy people in Russia. It is being built for the Russian workman, his wife, and his children. Now he dreams of riding around in his own cheap automobile, of having long hours of leisure, of enjoying to the full a chance to rest himself.

If these dreams are realized, what then? Will he and his sons be satisfied to remain Russian workmen? Similarly will his leaders be content with what they have wrought in their own nation or will ambition for world dominion seize them? These questions, and many, many others, are passing through the minds of world statesmen who are watching and wondering while the Soviet executes its plans for making a new nation.

How is Russia preparing to carry on its vast industrial job after the American engineers leave? What is being done to bolster Communism, to make it permanent? How are Stalin and his associates guarding against another revolution? How does the average Russian feel about easy marriage and easy divorce? These questions will be answered in May Popular Science Monthly, *on sale April 1.*

"Sure, I'll fix it! a soldering job can't bluff me now!"

"You're *almost* as good at fixing things as I am, Tom, but I'm one jump ahead of you. I do my own soldering now, because Kester has made soldering a *cinch*."

That's right. You don't need to be buffaloed by soldering any longer. Buy a can of Kester Metal Mender from your dealer. It carries the right flux for general soldering *inside itself*, so that all you have to do is apply heat. You'll get perfect results, too—a skilled mechanic couldn't do any better. The next time you make something that needs to be soldered, or are repairing anything around the house, use Kester Metal Mender. Kester Solder Co., 4201-05 Wrightwood Ave., Chicago, Ill. Incorporated 1899.

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AIR HUNT FOR GOLD

(Continued from page 25)

little village among the dense trees, completely sheltered from the view of a flyer, as was the trail that led to it. There, the village chief gave Long a diminutive burro, the village's only beast of burden, and walked beside him as Long rode in state toward Iguala. Shouldn't he ride in state on the chief's animal? Was he not the emissary of the white god who made people well, and had he not dropped from the air like a bird?

With their expressive signs, the Indians made it clear they had seen Long as he dropped from his plane. They had him under surveillance from the time his feet touched the earth. Long shuddered remembering what had happened to his companions on his visit four years ago. But the charm had worked. The white god was effective.

NEAR Iguala, staked down on a plateau about an acre in size, was the great bird from which the new white god had dropped. The chief turned his burro and, without a word or sign, started back on the long trail to his village that guards the city which Long believes was the last stand of the Mayas.

Back at his home, Long is preparing for an expedition. It will start this month, he told the writer, going by air to the little plateau near Iguala. Then it will proceed on foot to the mountain, and there it will uncover the home of a people long vanished.

Heading the party with Long will be Dr. Monday, whose private collection now holds priceless relics of a forgotten age, given him by natives as a tribute to the white god's healing power.

Thus another bit may be added to the rapidly growing knowledge of the mystery race of the North American world, the Mayas. Five hundred years ago, the lower Mexican peninsula was thickly populated with this great race, some estimates running into millions. These Central American Indians, perhaps the most civilized people of the New World, were adept at textile making and at astronomy and architecture.

The Mayan city of Tuluum, on the east coast of Yucatan, has been restored by the Mexican government with the coöperation of the Carnegie Institution. A tremendous temple, classic in its beauty and architectural fineness and the quality of its glistening white limestone; a great court where games were played, a huge astronomical observatory, elaborate sculpture of monoliths, pyramidal places of worship, and palaces—all have been recovered from the ruins.

AFTER the advent of the Aztecs, many of the Maya cities were buried. The Aztecs, like the Mayas, did not use beasts of burden other than men. Endless chains of sweating slaves, carrying baskets full of earth, buried from sight the marvelous structures which are now arousing the admiration of the world.

Somewhere in the southern part of the peninsula, after they had been driven from Yucatan and Tabasco and Chiapas, the Mayas made a stand. There they gathered in their last fight against extinction. There they herded up their slaves; there they built their last "capital" and their last defense against the hordes of Aztecs.

It is believed the Sierra Madre city, built in a niche in the hills and with entrances through the mountains from north and south, is that city. It is believed that there lies the treasure of a civilization that was more highly advanced than that of any other Occidental people. It is believed that there, in greater measure than anywhere else, is the secret of the Lost People of Maya.

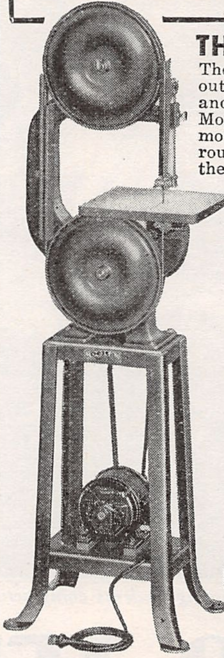
Real Woodworking Efficiency with *Delta* Motor-Driven Tools

THEY SAVE TIME and LABOR—produce better work

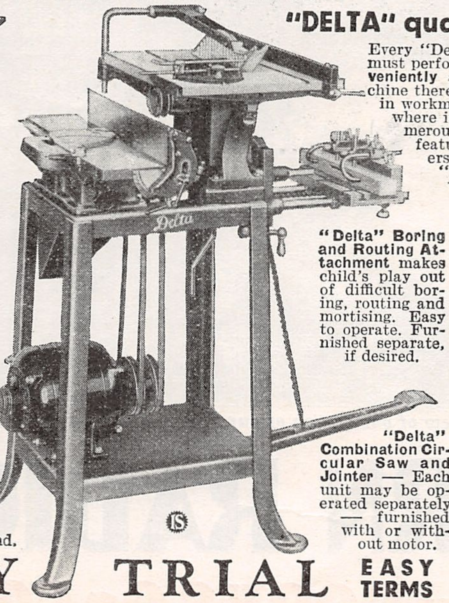
There is a new thrill in woodworking these days. Motor-driven tools have taken out all the drudgery, all the tiresome "elbow grease" from working with wood—and left only the sheer pleasure of making things quickly, easily and **beautifully.** Motor-driven band saws and circular saws have supplemented the hand saw . . . motor-driven jointers are replacing the hand plane . . . motor-driven borers and routers are eliminating hand drills and chisels. For this is a modern age . . . and the modern way is the motor-driven way!

"DELTA" quality—what it is

Every "Delta" woodworking machine must perform its work **efficiently, conveniently and quickly.** In each machine there is practical design, quality in workmanship and materials (even where it cannot be seen), and numerous exclusive constructional features. That's why woodworkers everywhere say that the "Delta" gives most machine value for the dollar.



"Delta" Band Saw has many exclusive features. Provided with extra-safe guard. With or without stand.



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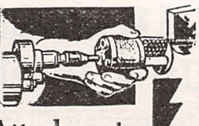

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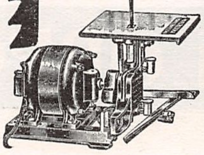

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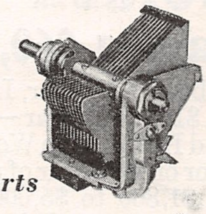

HAMMARLUND Condensers, Screen-Grid Coil and Choke form the backbone of the Three-Tube A. C. Broadcast Receiver featured in Popular Science Monthly.

There are more than 30 years of engineering experience back of Hammarlund Products—30 years of pioneering in the field of the telephone, telegraph and radio.

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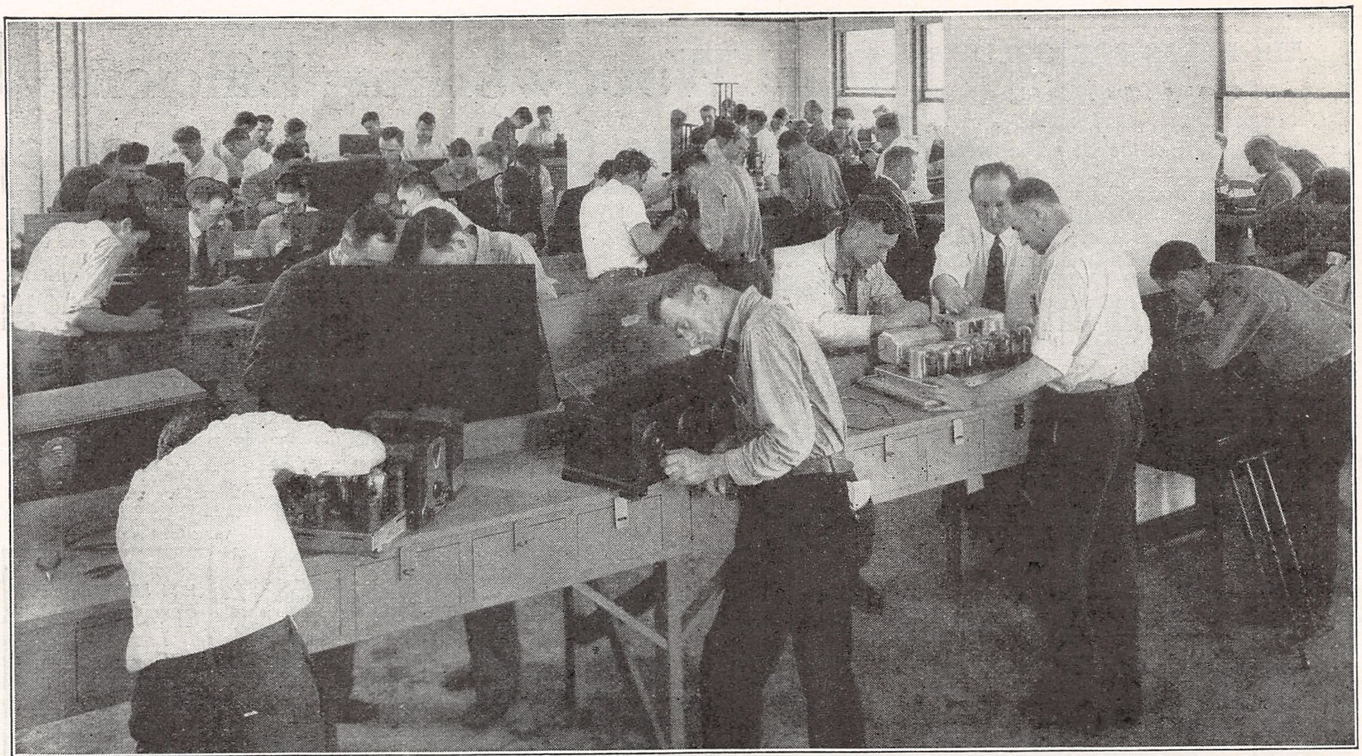
424-438 W. 33rd St., New York

For Better Radio
Hammarlund
PRECISION
PRODUCTS

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.



General view of one section of our Service Department, showing students doing actual work on various Radio Receivers

LEARN RADIO--TELEVISION

NOT By BOOKS Or CORRESPONDENCE - By

Don't spend your life slaving away in some dull, hopeless job! Don't be satisfied to work for a mere $20 or $30 a week. Let me show you how to make **real money** in Radio—the fastest-growing, biggest Money-Making Game on earth!

Golden Opportunities

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Jobs as Designer, Inspector and Tester paying $3,000 to $10,000 a year—as Radio Salesman and in Service and Installation Work, at $45 to $100 a week—as Operator or Manager of a Broadcasting Station at $1,800 to $5,000 a year—as Wireless Operator on a Ship or Airplane, as a Talking Picture or Sound Expert—THOUSANDS of OPPORTUNITIES LEADING to SALARIES of $60 A WEEK AND UP!

NO BOOKS -- NO LESSONS

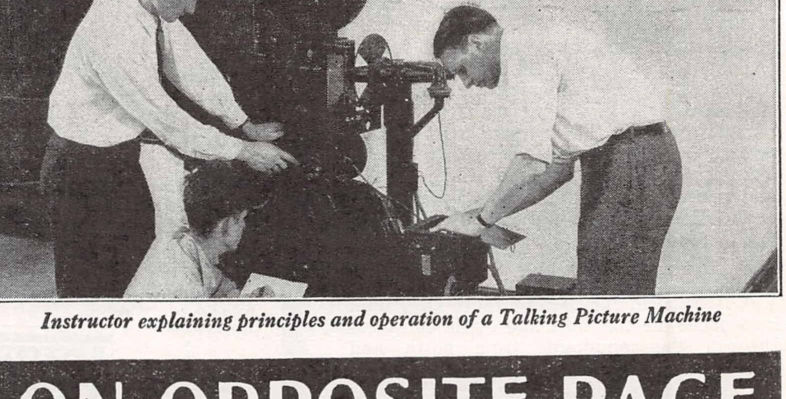
All Practical Work

Coyne is NOT a Correspondence School. We don't attempt to teach you from books or lessons. We train you on the finest outlay of Radio, Television and Sound equipment in any school—on scores of modern Radio Receivers, huge Broadcasting equipment, the very latest Television apparatus, Talking Picture and Sound Reproduction equipment, Code Practice equipment, etc. You don't need advanced education or previous experience. We give you—**right here in the Coyne shops**—all the actual practice and experience you'll need. And because we cut out all useless theory, you graduate as a Practical Radio Expert **in 10 weeks' time.**

TELEVISION

IS NOW HERE!

And Television is already here! Soon there'll be a demand for **Thousands of Television Experts!** The man who learns Television **now**



Instructor explaining principles and operation of a Talking Picture Machine

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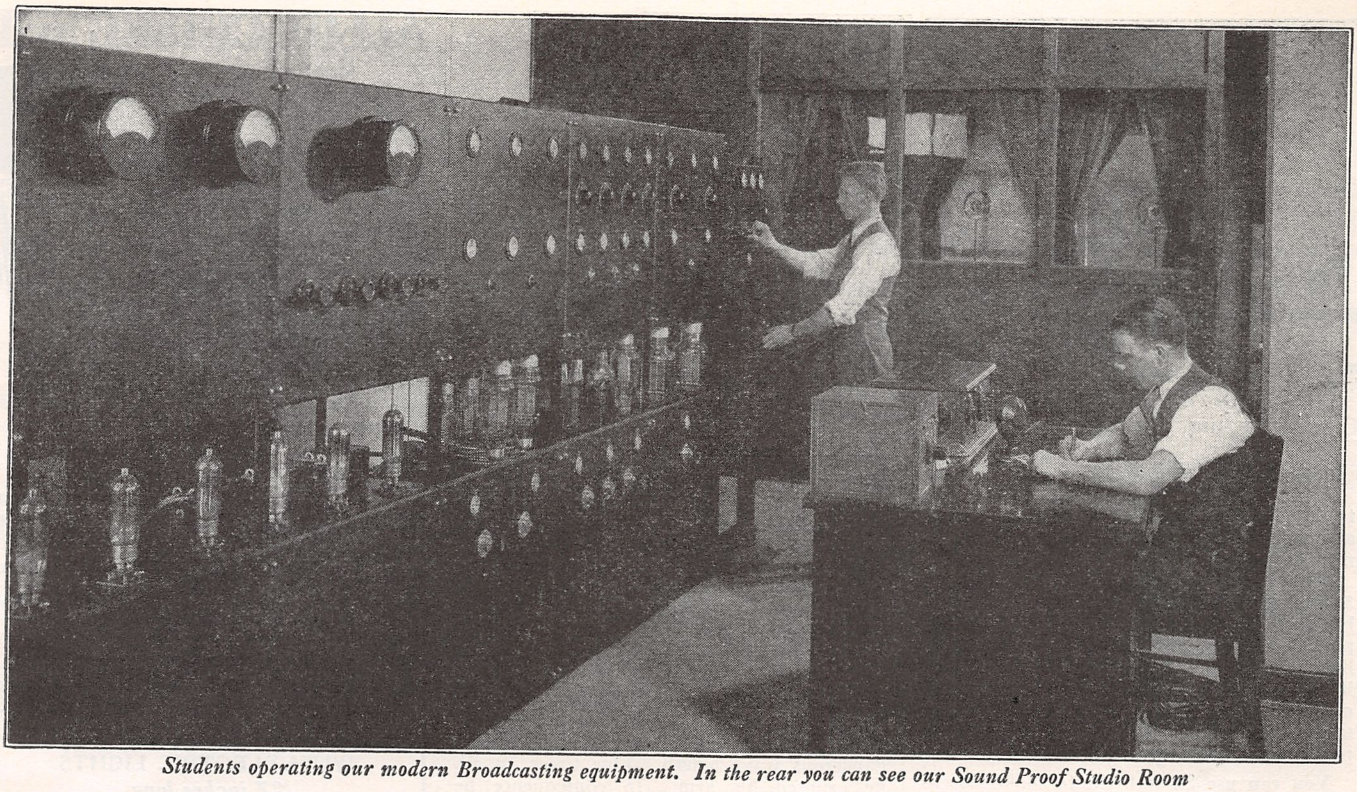

Students operating our modern Broadcasting equipment. In the rear you can see our Sound Proof Studio Room

TALKING PICTURES in 10 WEEKS

Actual Work - In the Great Shops of Coyne

can make a FORTUNE in this great new field. Get in on the ground floor in this amazing new Radio development! Come to COYNE and learn Television on the very latest Television equipment.

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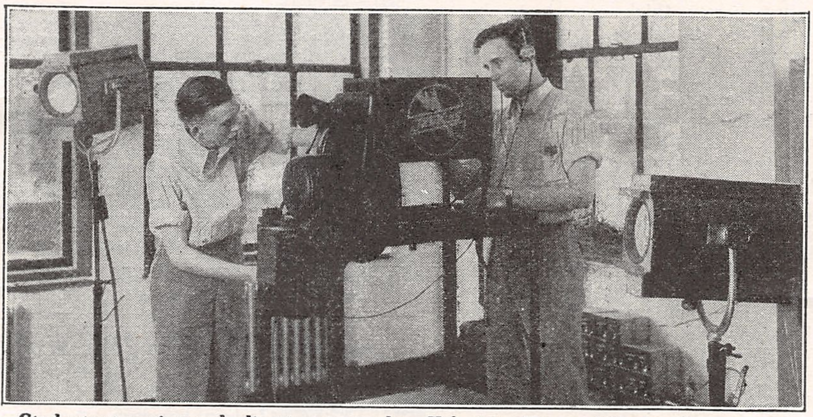
Talking Pictures and Public Address Systems offer thousands of golden opportunities to the Trained Radio Man. Here is a great new field of Radio work that has just started to grow! Prepare now for these marvelous opportunities! Learn Radio Sound work at Coyne on actual Talking Picture and Sound Reproduction equipment.



Students operating and adjusting our modern Television Transmitting equipment

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You get Free Employment Service for life. And don't lack of money stop you. If you need part-time work while at school to help pay living expenses, we will gladly help you get it. Many of our students pay nearly all of their expenses that way. You can find out everything absolutely free by simply mailing the coupon below.

COYNE IS 32 YEARS OLD

Coyne Training is tested, **proven beyond all doubt.** You can find out everything **absolutely** free. How you can prepare for a good job or how you can go into business for yourself and earn from $3,000 to $15,000 a year. It costs **nothing** to investigate! Just mail the coupon for your copy of my big Free book!

H. C. Lewis, Pres. **RADIO DIVISION** Founded 1899

COYNE ELECTRICAL SCHOOL

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Send me your Big Free Radio Book and all details of your Special Introductory Offer. This does not obligate me in any way.

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HOME and AUTO REPAIRS
STOPS LEAKS
SMOOTH-ON No.1
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WITH SMOOTH-ON

YOU can save $20.00 in no time by using

SMOOTH-ON No. 1

to do your own household repairing—and in addition you will have that proud "I-did-it-myself" feeling.

Here is what one enthusiast did with two 35-cent cans:—A $25 lamp stand loose in base, two big leaks in heating furnace smoke pipe, loose hammer handle, and three loose hooks in tiled bath room wall were all put into good usable condition at an average cost of 10 cts. for each repair—and $20.00 easily saved over what would have been paid to professional fixers or for new parts.

You can use Smooth-On to make dozens of home repairs simple. Try it the next time you have a leak in steam, water or gas pipe, boiler, furnace, radiator, hot air duct, etc. Seals holes in pails, sinks, tanks. Makes loose handles tight. Enables you to fasten brackets, shelves and hooks in masonry walls. Makes loose screws, anchor bolts, nuts, locks, hinges tight.

Smooth-On does not deteriorate. Keep a can in your home and you will be repaid many times over.

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Smooth-On No. 1, being unaffected by water, oil, gasoline or heat, is also excellent for automobile repairs. Try it for stopping radiator, tank, pipe line and hose connection leaks from the outside, keeping exhaust line connections tight to prevent the escape of obnoxious burnt gases, repairing cracked water jackets and crank, gear and differential cases, keeping grease cups, lubricator connections, nuts and hub caps from loosening and falling off, tightening loose hinges, robe rails, etc.

The FREE Smooth-On Repair Book

will show you how an astonishing number of home and automobile repairs are as easy for you to make as for somebody else.

Mail the coupon for a free copy and get Smooth-On No. 1 in 7-oz. or 1 or 5-lb. can from any hardware store or if necessary direct from us.

STOPS LEAKS
SMOOTH-ON No.1
CEMENTS IRON

Smooth-On Mfg. Co.
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JERSEY CITY, N. J.

Do it with SMOOTH-ON

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Please send the free Smooth-On Repair Book.

Name ....

Address ....

4-31 ....

Return this coupon for a FREE copy of Booklet

FINDS WAY TO TUNE RAYS OF ULTRA VIOLET

(Continued from page 43)

germs. According to his theory, any such effect should start abruptly at a certain wave length and continue for shorter ones. All he wanted was a chance to try it and see.

The trustees of the university were less enthusiastic than the president, but eventually they found a place for Sperti to work. It was a large garret used by the janitors for storage!

Sperti chased out the janitors and began his pioneer experiments. One of them startled his friends.

DELIBERATELY Sperti scarred himself in order to prove that one brand of ultra-violet light was fatal to human tissue and another was not. One day in his laboratory, he stood in front of a powerful super-sunlight lamp. Fastened to his forearm, placed squarely beneath the lamp's intense rays, was a cardboard mask with a star-shaped hole cut in it.

Repeatedly Sperti exposed his arm beneath rays he felt sure, from his calculations, would be fatal to human skin. Also, he exposed other patches of skin to ultra-violet rays fully as intense, but not of the dangerous wave length. Five times, in all, he exposed his arm. In consequence he carries today the branded mark of the star *wherever the rays his calculations warned him against had struck him.* The others had no effect!

This unique test not only showed Sperti he was on the right track, but it also revealed facts of interest to every sunbather.

The first three exposures were beneath filters transmitting rays like the ultra-violet in normal sunshine; the shortest of the three, however, is found only on high mountains. They left no mark, a slight mark, and a very red patch of sunburn respectively. Later tests showed that each of these wave lengths form beneficial Vitamin D in the human body.

The shortest two wave lengths of ultra-violet that Sperti tried have no equivalent in Nature, at least, not on this planet, where a thick blanket of air strains such short waves from the sun's rays. Only powerful electric lamps can generate them. These rays inflicted burns so severe that no human being could stand in them for long and keep on living.

What a happy arrangement of Nature it is, Sperti points out, that the air on the earth is just barely thick enough to bar entrance to these dangerous rays, and just thin enough to let through the healthful, ricket-preventing ones. Only a little change one way or the other, and we might be burned to death—or boneless.

ONE of the first fruits of Sperti's work with "tuned" ultra-violet rays was the discovery of a "death ray" for disease germs. Hunting down the particular ray in ultra-violet light that is responsible for sunshine's known germ-killing power, this scientific detective found it almost at the borderline of the sun's sheaf of rays. While germs in his laboratory basked unconcerned in glass dishes for days at a time beneath ultra-violet rays of longer wave length, they instantly perished when Sperti turned this ray upon them.

Encouraged by such triumphs, Sperti started on the trail of the elusive Vitamin D. Recently chemists had discovered that nearly all things animal or vegetable, including bread, milk, and the oil of human skin contain minute quantities of a powerful chemical called "ergosterol." It is this chemical upon *(Continued on page 133)*

ALLOY CHISEL SET

MADE OF BOB CAT SPECIAL ALLOY STEEL

ALLOY BOB-CAT STEEL
8"
6¾"
6"
5¾"
7/8"
3/4"
5/8"
1/2"

A supremely tough, hard metal which holds an edge even when used for worst jobs imaginable. Set consists of four pieces; sizes 7/8", 3/4", 5/8", 1/2". Handsome black krinkle finish. Use this set JUST ONCE and you'll ALWAYS keep it handy.

Hinsdale Center Punch FREE if you order from this ad.

GUARANTEED *to give Satisfaction for a Lifetime*

ONLY $1.25 Per Set
Plus Parcel Post C. O. D.

Send No Money Just write: "Send C.O.D. Parcel Post, one 4-piece Hinsdale Bob Cat Chisel set and free Hinsdale Center Punch." Pay postman $1.25 plus parcel post charges. Money cheerfully refunded if you're not satisfied.

HINSDALE MFG. CO.
Established 1919 237 N. Desplaines St., Chicago

A CLIPPER SHIP FOR $4.50
WITH ELECTRIC LIGHTS
27 inches long

We supply all the parts, cut and numbered ready to put together. Instructions show full details how each numbered part fits into the other. A few hours of pleasant pastime and you will have a beautiful and valuable model. We also have parts for the Santa Maria, La Pinta, Mayflower, and Flying Cloud at $4.50 each. Constitution (Old Ironside), $5.98. Flying Cloud with electric lights, $4.50. We also have kits for COACH MODELS; Deadwood Stage, Tally Ho, George Washington's private coach, Devonport to London, Princeton to Philadelphia, Overland, at $4.98 each (less horses). Horses $2.00 per pair. Models sent C. O. D. plus postage. U. S. money order or check must accompany all foreign orders.

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3216 Baring Street Philadelphia, Pa.
Originator of Build-your-own-ship-models

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Build Your own CLOCK

FREE BOOK Shows How YOU Can Make Fine Clocks Right at Home

of Clock Making, *Money Making* ideas. Gives details, prices of movements parts. Write *Now* for copy!

—for yourself, or to sell at Big Profits. We furnish instructions, parts. Works $1.65 up; others with chimes, all prices. *Cash-in* on demand for Mantel, Banjo, Grandfather's Clocks. Ask about new low priced Electric Clock and Special Blue Print Offer. FREE Catalog.

AMERICAN CHIME CLOCK COMPANY
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MAKE YOUR INVENTIONS PAY

Millions have been made from ideas properly developed and protected by inventors. One of the first steps is the development of a practical working model.

Send us rough sketch or model of your idea. We will submit complete report backed by 30 years' experience in model making. Confidential service. Modern equipment. Bank references furnished. FREE booklet "Making Inventions Pay."

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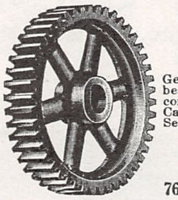

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In Stock—Immediate Delivery

Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special gears of any kind. Send us your blue prints and inquiries.

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CHICAGO GEAR WORKS
769-763 W. Jackson Blvd., CHICAGO, ILL.

SAMPLES OF 33 RARE WOODS

ONLY $2.00

20 cabinet woods—$1.00
Sets labeled and postpaid.

Lumber domestic and imported, panels, veneers, inlay woods, turning squares, and supplies.

Send 5c stamp for large illustrated catalogue.

CRAFTSMAN WOOD SERVICE CO.
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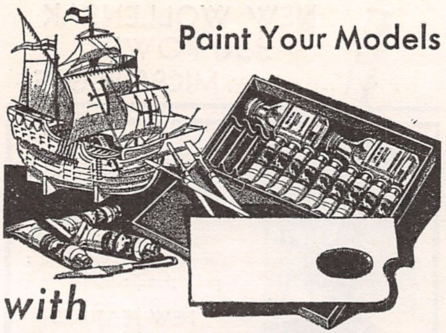
Chicago, Illinois

A definite program for getting ahead financially will be found on page four of this issue.



Paint Your Models

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Brilliant, Striking

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Artists' Colors

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BUILD MODEL SHIPS OF THE BETTER KIND

Special Construction Set and All Sorts of Parts for U. S. Destroyer Preston

We can also supply construction sets, flags, steering wheels, guns, capstans, anchors, blocks, deadeyes, blue prints, books, etc., for building models of the Flying Cloud, Constitution, Spanish Galleon, Mississippi Steamboat, Sovereign of the Seas, Bluenose, Mayflower, Viking, Baltimore clipper and many others. Also special construction sets for racing sail boats, power boats, model steam engines, propellers, etc., and fine tools for the model maker. Our large 56 page photographically illustrated ship model booklet contains valuable information and hints for building ship models, in addition to prices, and full description of the above articles. Many people only slightly interested in models, have become greatly enthused upon receiving this booklet. A copy will be mailed postpaid upon receipt of 15c (coin preferred).

MODEL SHIP SUPPLY COMPANY

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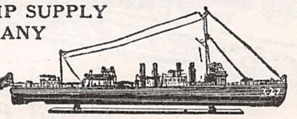


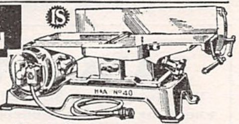
LOOK FOR THE FULL NAME ON THE SHANK OF GENUINE..

Russell Jennings AUGER BITS

AT GOOD HARDWARE STORES

The Russell Jennings Mfg. Co., Chester, Conn.

Be a MASTER CRAFTSMAN



H & A Jointer

New Easy way to do expert home woodwork. Finest cabinet and pattern designs. Make chairs, trellises, book-ends, etc. H & A Jointer helps you turn out perfect planing, jointing, beveling, and rabbeting. Easy to use. Highest quality, unusual accuracy. Preferred by industrial users. Plugs right in the light-socket. Ball-bearing. Safe. Fast. Send for FREE H & A woodworking equipment catalog, and reasonable prices. Write today.

HESTON & ANDERSON 804 STONE STREET FAIRFIELD - IOWA

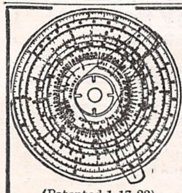
Tool Chests for Machinists and Toolmakers

Quality Materials and strong construction.

FREE Catalog

H. GERSTNER & SONS

588 Columbia St., Dayton, Ohio.



(Patented 1-17-22)

The Midget "*Five-in-One*" Slide Rule

is a combination Mannheim, Polymetric, Log Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Fabricoid Case 50c extra, Sent C.O.D. if desired. Catalogue Free. GILSON SLIDE RULE CO., Stuart, Florida.

A definite program for getting ahead financially will be found on page four of this issue.

FINDS WAY TO TUNE RAYS OF ULTRA VIOLET

(Continued from page 132)

which ultra-violet rays act, literally turning it into Vitamin D.

When Sperti set out to calculate the exact wave length of ultra-violet that produced this effect upon ergosterol, his figures produced startling results. They showed that the production of Vitamin D in ergosterol should begin at a certain wave length near the end of normal sunlight. Going down further, a point should be reached where the ultra-violet rays would *destroy the vitamin as fast as it formed.* Because of this you could only produce about ten percent of Vitamin D in ergosterol, instead of a hundred percent. Trying it out, Sperti found it was true. By avoiding or "tuning out" the destructive ray, he manufactured pure Vitamin D from ergosterol. When he fed minute quantities to ricket-afflicted chickens in his laboratory, they were cured with amazing speed.

NOW Sperti was ready to put vitamins in food, on a scale never possible before. He had his choice of two methods—to place the food itself under the lamps, or to add to it small quantities of treated ergosterol, which is tasteless. Special considerations prompted his choice.

It would be easy for him to put bread under the sunlamps and put the vitamin in it. But since the ultra-violet rays do not penetrate deeply, most of the vitamin would be in the crust. And many children throw away the crusts. So Sperti chose the method of adding "rayed" ergosterol to bread.

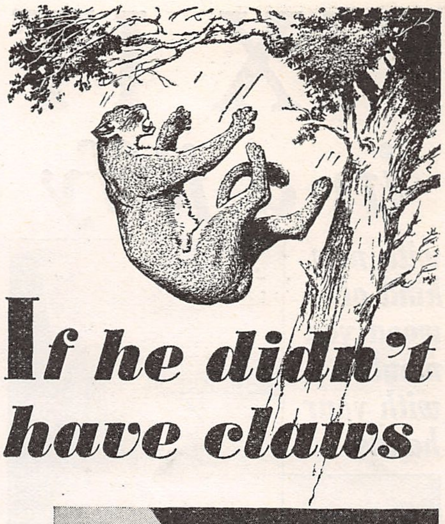
Putting vitamins in milk, however, was a different problem. As described before, the difficulty was that general "raying" spoiled the taste. Sperti traced this to a certain ray that formed ozone in the milk. He rejoiced to find that the taste-spoiling ray was safely outside of the band that produces the vitamins. Inserting the proper light filter, he was able to put the vitamins in without altering the taste.

An unexpected use for Sperti's process was found in preserving foods. Orange juice, for example, soon gets muddy and turbid when it is kept for any length of time. Grapefruit juice and tomato juice are other products for which manufacturers would be grateful for means of keeping. Here enzymes are the culprits. Sperti tried subjecting these juices to his "tuned" ultra-violet rays. Recently he exhibited a sample of orange juice so treated, kept for eight months, and still clear and of natural flavor.

Decay from other causes is equally easy for Sperti to prevent. He has merely to turn on his "death ray" and the germs die an untimely death.

IN other words, Sperti's experiments in preserving foods open new vistas of a time when, even more than at present, we shall be entirely independent of the seasons in choosing what to put on our dinner tables. Great warehouses stocked with preserved food will keep supplies available all the year round.

So varied are the applications of Sperti's rays that no one can say where they will end. Florists may use the new "tuned" ultra-violet light to grow better flowers. Poultry raisers should be able to raise bigger and healthier chickens on cheap, "rayed" poultry feed. These possibilities are to be investigated. For Sperti has come out of the garret. In recognition of this amazing young man's work, a huge new laboratory, equipped with the finest scientific equipment that money can buy, is being built for him. Here he will seek new ways to apply the wonders of his "tuned" ultra-violet rays.


If he didn't have claws

The RIBBED BLADE WON'T SLIP
Red Crown

A SCREW driver without the *Non-Skid* point is like a lion without claws—*it can't get a grip!*

The Non-Skid *grips* the sides of the screw slot—*prevents* slipping! This remarkable *gripping power* makes it so much *easier* and *safer* to drive and draw screws with the new Bridgeport Red Crown Non-Skid Screw Driver. So why continue to struggle with the smooth, slipping, slashing out-of-date screw drivers. Save time, temper and tribulation—"tool yourself up" with a Non-Skid today. It's GUARANTEED!

Made in 3 styles—all with blades of electric-furnace, chrome vanadium steel. No. 1 (Blade runs clear thru handle) 4", 50c; 6", 60c. No. 2 (Blade, handle and ferrule securely riveted) 4", 35c; 6", 45c. No. 3 (Shockproof up to 18,000 volts) 4½", 45c; 6½", 55c. If your dealer can't supply you, order direct.

THE BRIDGEPORT HDWE. MFG. CORP.
Bridgeport, Connecticut

Bridgeport TRADE MARK
NON-SKID
Screw Drivers

FIX IT
in a jiffy

with new kind of wood you mould with your hands

PLASTIC WOOD

THOUGH it handles like putty, it quickly hardens into wood and looks exactly like wood. It is wood—Plastic Wood you can easily mould with your hands and do repairing jobs that an expert cabinet-maker, carpenter or tinker would be proud of.

Never dries out. Never warps, shrinks, splinters or rots after it once hardens. You can plane it, carve it, turn it in a lathe and paint, lacquer or varnish its weatherproof, waterproof surface. It takes and holds screws, nails and tacks.

A loose chair rung or a weak chair back—a drawer pull that comes out—a loose caster—a broken toy—cracks in the floor or between bathroom tiles—holes in the floor—fix it yourself with Plastic Wood and save a lot of money. At any paint, hardware or department store get a can or tube of Plastic Wood.

Big Book of Uses—FREE

You'll get a great big, profusely illustrated book of 48 pages crammed full of interesting uses for this remarkable new kind of wood that handles like putty, hardens into wood and comes in 9 different colors . . . if you mail this coupon.

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Send me—free—big, illustrated book of uses for PLASTIC WOOD.

Name..
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POISONS THREATEN YOU AT HOME

(Continued from page 29)

diseases and sold a concoction which he called "Horsetail Tonic." It was made from the common "horsetail plant," and while not poisonous was of no value for treating the disease it was supposed to cure, so far as the Government experts could detect.

In another case, a farmer noticed that chickens ate sand and thrived on it. So he assumed sand was what the human system needed. He put up a preparation for sale which was composed of ninety-eight percent quartz grains with a little baking soda and cayenne pepper added. A second experimenter created a more palatable cure-all by reducing the sand content to eighty-seven percent and adding rock candy. Another amateur remedy, sold under the attractive name of "Health Ease," was found to be composed of ninety-five and a half percent pure lard, when it was examined in the laboratory.

WITH ignorant persons given a free run of poisons in preparing their nostrums, the danger of taking medicine without a doctor's prescription increases. Without competent advice, the temptation to take more than the usual dose is also greater.

Taking an overdose of a medical compound is only one of the dangers of poison in the home. There are many instances of people getting the wrong bottle from medicine cabinets stocked with poison-containing drugs, when reaching into it in the dark. Frequently it has been suggested that peculiarly-shaped bottles, or those studded with knobs or points, be required for all poisonous medicines, so they can be recognized instantly by the sense of touch. Often, preparations like tan and freckle removers, containing corrosive sublimate and ammoniated mercury, a powerful caustic poison, are kept on medicine cabinet shelves and may be mistaken for harmless drugs in the darkness.

However, the medicine cabinet is not the only source of poison in the home. Not long ago, a life insurance company in New York City issued statistics showing the menace to small children that lies in the lead paint that sometimes is used to color toys, cribs, and woodwork. Severe cases of lead poisoning have resulted when children sucked or chewed off such paint and swallowed it. The danger is greatest when the toys or cribs are recoated with a cheap grade of paint containing a large proportion of lead. The harmless-looking white, appearing sanitary, really is more dangerous than wicked-looking red, for example, because it contains greater quantities of white lead.

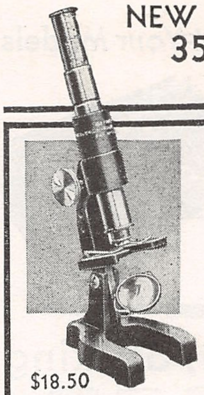
MANY of the new lacquers and enamels, which are put on by the spray process, eliminate the poisonous lead bases. One of the leading toy manufacturers makes a special advertising point of the fact that all his products are coated with paint that is entirely harmless.

Crayons are another conveyor of poison. Small children have sometimes mistaken them for stick candy and eaten them with serious results. Many such crayons contain chromium, a poison that thins the blood and turns it black. The cheaper varieties of artists' crayons and colors commonly contain arsenic. Other crayons contain white lead, and others Prussian blue, closely related to hydrocyanic acid, one of the most deadly poisons known.

In the large apple orchards of the country, lead arsenate is sprayed on trees and fruit to fight insects. If the apples are sold without being treated, the residue of this poison spray becomes a menace in the homes where they are eaten.

(Continued on page 135)

NEW WOLLENSAK
350 POWER
MICROSCOPE



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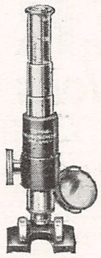

With stand detached for examining bulk

The convenient size, simple manipulation and precise optical qualities of this new microscope will appeal to amateur scientists, growing boy or girl, as well as the professional man.

NEW FEATURES

Affords magnification from 100 to 350 power accurately graduated in steps of 50 power. Concave mirror...rack and pinion . . . tilting stand enabling microscope to be used in all positions . . . detachable base which simplifies the examination of any matter that cannot be conveniently placed on stage.

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Money back guarantee.

Wollensak 50 to 110 power microscope with rack and pinion . $10.00

Catalogue free.

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Lens problems our specialty

WRIGLEY'S
THE FLAVOR LASTS
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THE PERFECT GUM
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Good and
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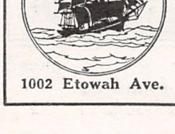

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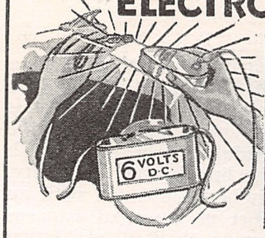

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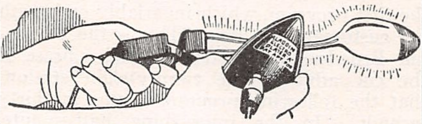

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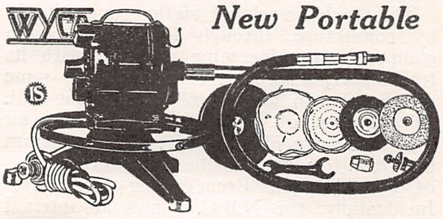

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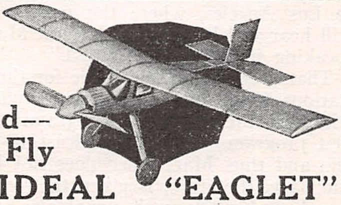

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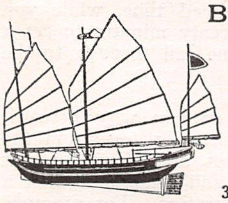

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POISONS THREATEN YOU AT HOME

(Continued from page 134)

It may produce double poisoning, as though both lead and arsenic were taken into the system. The usual procedure in removing this residue is to put the fruit through a mild hydrochloric acid bath.

At the Oregon Agricultural Experiment Station, Corvallis, it was found that sometimes the natural wax of the fruit, or the oil, when oil sprays are used, forms a coating over the surface of the apple and prevents the acid from reaching the arsenical particles below. In order to discover a solvent that could be added to the bath to dissolve this coating, R. H. Robinson, chemist at the station, recently made a series of tests in which he tried out alcohol, acetone, benzol, carbon tetrachloride, kerosene, and gasoline. He found the most satisfactory bath was made by adding kerosene to the acid wash. This discovery practically eliminated the danger of poison spray residue remaining on apples that have been treated.

When arsenic, lead arsenate, or other spraying materials are kept in the home, the hazard of poison is increased. There is always danger that such death-bringing dust may become mixed with food. Such an accident, just before Christmas, 1929, gave Government officials an exciting chase to recover nine deadly fruit cakes.

In Virginia, a housekeeper conducted a small retail business in home-cooked fruit cakes for the holiday. Nine of the delicacies were sold. A near-by neighbor was the first to open one. Six guests who tasted it were made violently ill. The remains of the cake was immediately sent to the Pure Food and Drug laboratory in Washington for analysis. Here, "Spot," a small fox terrier belonging to one of the scientists, proved the hero of the investigation. The physicians treating the sick people did not know what poison they were dealing with. In order to find out as quickly as possible, a small piece of the cake was fed to Spot. After nibbling a taste, he was attacked with the violent, explosive type of vomiting which is peculiar to arsenic poisoning. This information helped save the lives of the stricken guests.

The source of the poison in this case was traced to insecticide which had been stored on a shelf in the kitchen for several years. This calcium arsenate was a white powder easily mistaken for flour. The theory is that somebody accidentally emptied the sack of poison into the flour bin.

Other cases of similar accidents have turned out less fortunately. When rat poison was spilled in a sack of sugar in an Indiana store, some years ago, two of the many people made sick by the contaminated sweet died. In Los Angeles, in 1926, nineteen persons were made seriously ill from eating pies that contained arsenic, accidentally mixed with the ingredients.

"A package of poison on the pantry shelf," says Dr. P. B. Dunbar, assistant chief of the Food and Drug Administration, "is more dangerous than a loaded gun."

Simple rules, emphasized by Government experts, should guide the handling of poisons and poison-containing drugs in the home. Keep insecticides away from the pantry. Store them on a high shelf out of the reach of children. Keep medicines containing poisons on the upper shelves of the medicine cabinet. Get a prescription from a physician before taking drugs containing dangerous ingredients. If you take patent medicines purchased at a drug store be sure to follow the directions. Don't take larger doses than the directions indicate.

Singing Shave

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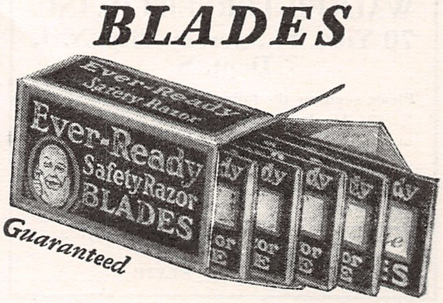

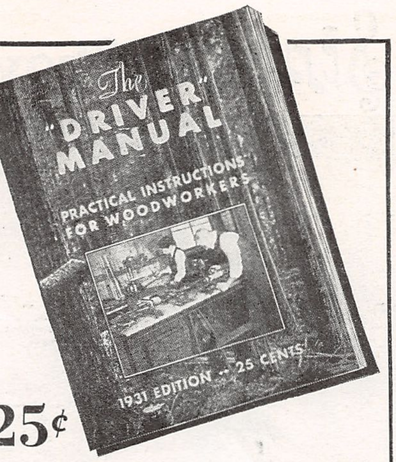

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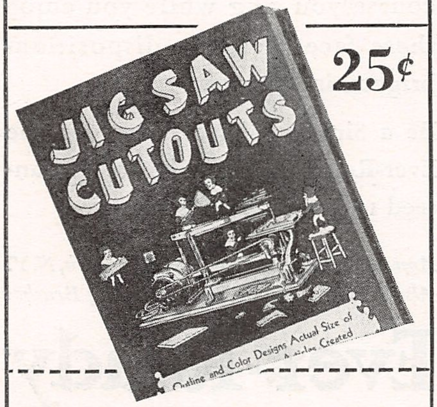

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WIRE MEN WORK RADIO MARVELS

(Continued from page 27)

business. Today, networks literally cover the country like monstrous spider webs. With two networks comprising seventy-six stations, the National Broadcasting Company, for its private use, leases from the American Telephone and Telegraph Company 18,000 miles of wire lines—enough wire to span the width of the continent five times!

The Columbia Broadcasting System, which also includes seventy-six stations in seventy-three cities, leases 13,500 miles. The N.B.C. now is the world's largest telephone user. Its phone bill for 1930 was $2,750,000—more than $7,500 a day! Columbia, too, spent more than $2,000,000 in telephone charges during the year.

BESIDES, the N.B.C. leases 10,000 miles of telegraph wires connecting the network stations with the master control room in New York, enabling engineers and operators to communicate with each other almost instantaneously. The Columbia System maintains a similar service. On the desk of Edwin K. Cohan, Columbia's technical director, there is a Morse instrument by means of which he can "talk" simultaneously to the system's seventy-six stations.

The reason for these giant wire set-ups and enormous phone bills becomes clear when it is realized what the big broadcasting companies are doing nowadays in the way of network broadcasting.

For example, last New Year's Eve between nine P. M. and two A. M. Station WABC, New York City key station of the Columbia Broadcasting System, in an international celebration of the air, made virtually the entire American continent into one gigantic studio. To add to the country's gayety, this one station, in those five hours, rebroadcast to the four corners of the United States musical programs and New Year's greetings picked up from these far-flung points:

At 9:15, Minneapolis, Minn.; 10:15, Buenos Aires, Argentina; 10:30, Boston, Mass.; 11:15, Montreal, Canada; 12 o'clock, Los Angeles, Calif.; 12:30, Toronto, Canada; 1:15, Chicago, Ill.; and 1:45, Toledo, Ohio. While, at midnight, revelers in New York heard the blare of a jazz band in Los Angeles, where then it was only eight P. M., the Pacific Coast city through a nation-wide hook-up of the National Broadcasting Company heard the chimes of Trinity Church, New York, ring out the old year and ring in the new.

A sheet of the WABC master control log covering the New Year's Eve activities lies before me. From the chief control man's comments recorded there, it appears that each of these distant pick-ups was clear, came in on time, and went out on the dot. What made all this possible? Wire lines, highly improved and expertly engineered, is the answer.

ONE evening last May an office boy handed Cohan a newspaper telling that the Ohio State Penitentiary at Columbus was in flames. No sooner had he read the news than he got busy with his Morse key. A microphone was installed in the prison yard and within one hour the seventy-six stations of the Columbia System were broadcasting the actual sounds of the tragedy.

New Year's Eve, you may say, was a special occasion, probably involving unusual preparations, and the Ohio fire was an emergency. True. Similar efforts and results, however, now are part and parcel of an ordinary day's work in radio.

The big broadcasting companies have reduced their end of network broadcasting to a science until, nowadays, whole cities and even entire sections of the country are "plugged" in and out like local calls on a telephone switchboard. Naturally, the time element plays an all-important part, as it is vital that programs begin and end on the precise second scheduled. The stop watch is the badge of the broadcasting fraternity.

The technique is best illustrated with an actual example. Let us see what happens every Tuesday evening at 10:30 at Station WABC, New York. From 10:15 to 10:30 an orchestral feature is fed to a network of thirty-four stations. At 10:30, a variety entertainment is broadcast over a nation-wide network of sixty-two stations. Both programs originate in New York.

This is how the hook-up is widened to include the twenty-eight additional stations without creating what the broadcasters call "dead air"—that is to say, a silent period:

THE twenty-eight stations joining the network at 10:30 listen to the conclusion of the first program, which invariably ends with the customary tag-line: "This is the Columbia Broadcasting System." This phrase is the cue advising the twenty-eight stations that the following program begins in thirty seconds. In the intervening half-minute, they must wind up their own programs, make their local announcements, and join the network.

This each associated station does simply by connecting, through its control room equipment, the incoming program with its transmitter, a process essentially the same as plugging in an incoming telephone call. In the case of N.B.C., the cue, as you doubtless have observed, is: "This program has come to you from the New York studios of the National Broadcasting Company." Incidentally, the N.B.C. allows an interval of only fifteen seconds to elapse between programs.

Now, suppose that a program is distributed only to a group of eastern stations, and the next feature, originating in southern California, is to be fed to a nation-wide network. In such an event, you may hear the New York announcer say, at the close of the first program: "We will now take you to Los Angeles, where the next voice you will hear will be that of Graham MacNamee speaking from the Rose Bowl."

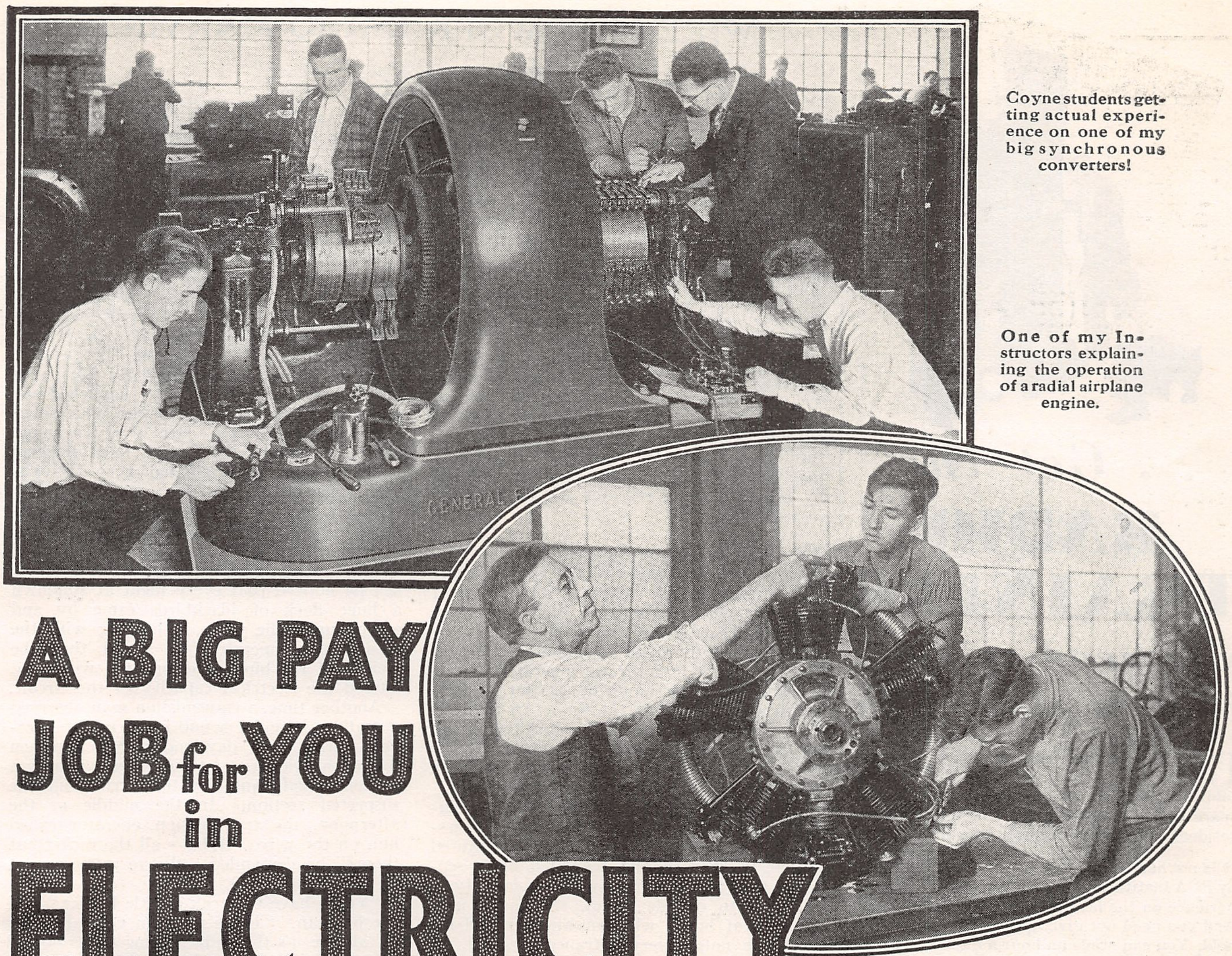
That is the prearranged cue for the eastern stations in the preceding network which also will take the California program. But the first program was not broadcast to California, and thus MacNamee does not hear the cue. He, therefore, is given the "go-ahead" signal, and a telegraph signal also is flashed to the stations so located as to be unable to listen in on the preceding feature.

This smoothly working system, together with the fact that the broadcasting companies use private wires, explains why a network program originating hundreds, or even thousands, of miles away, comes from your loudspeaker on scheduled time, while you may have to wait twenty minutes to get a long-distance telephone call through to the next town.

BUT it does not explain why network broadcasts are virtually free from the hum, extraneous noises, and distortion that mar a long-distance and sometimes even a local telephone conversation. For example, the voice of an opera singer sent by telephone wire from Chicago to New York and San Francisco sounds as clear as a bell. If the same artist, however, sang to you on the telephone, even over a short distance, the effect would be far from enjoyable.

The reason is that no stone is left unturned to

(Continued on page 138)



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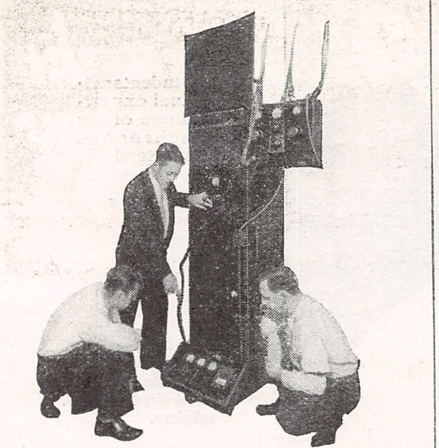

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WIRE MEN WORK RADIO MARVELS

(Continued from page 136)

improve the quality of telephone transmission of radio programs. Transcontinental broadcast programs cross the continent over one of three major wire circuits—luxurious boulevards of broadcasting, rigidly policed and patrolled by expert transmission men. There is the northern route, through Montana and Minnesota; a central circuit, crossing the Middle West via Denver and Omaha or Kansas City; and the southern route, swinging across the Texas Panhandle north into Chicago.

At intervals of fifty miles on the cable circuits, and of 150 miles on open wires, are repeater stations, where amplifiers make up for losses en route. The location of these repeater stations is fixed by mathematical formulas. Wherever engineers determine that the tiny voice currents must be boosted by relays, there a repeater station must be located.

In THESE repeater stations the transmission men, patrolmen of the electric highway, listen carefully to every sound coming over the wires. They are linked by telegraph, for each is an expert Morse operator as well as a thorough telephone technician. A crackle or a thump in an operator's loudspeaker brings an inquiring chatter of telegraph sounders along the line. An instant's Morse-code conference determines the source of the noise. Operators make hasty repair or switch a new link into service, but the program goes on without interruption.

At terminal points, where both incoming and outgoing programs may be passing over the wires, each program is monitored—that is, checked and regulated by a separate transmission man, whose sole duty is to listen to outside noises. Stationed in a soundproof booth with loudspeaker and log book, he notes every extraneous sound, no matter how minute. His record, couched in professional jargon including such terms as "chirps," "cuts," "cross-talk," "hits and swings," "pops, thumps, and scratches," "cross-tone," "Morse thumps," and "delays," forms a basis for checking against wire trouble of all kinds.

Although broadcast programs use the wires only a part of the time, maintenance men are busy twenty-four hours a day measuring, testing, and balancing the circuits. The "length" of the line, in electrical miles, varies from hour to hour with fluctuations in temperature and humidity. A sudden cold snap causes a marked change in the resistance of the wire, throwing circuits out of balance. Rains or heavy fogs alter the electrical capacity of the circuit, introducing distortion.

THROUGH tests made with an oscillator producing musical tones of known frequencies, transmission men compensate for these changes and keep a high standard of distortion-free transmission. Their goal is perfect fidelity of tone over a range from 100 to 5,000 cycles. A frequency band of but from 250 to 2,500 cycles per second is sufficient to transmit intelligible speech in an ordinary telephone conversation. There, in a nutshell, is the reason for the difference in quality.

Of the entire network, by far the most vulnerable part is the thousands of miles of open-wire circuits, fully exposed to the mercy of the elements. To see that these channels are kept open at all times is a real job for the transmission men, aided though they are by the finest instruments.

When a flaw develops in the line, a transmission man steps to a cabinet and plugs a delicate instrument into the circuit. Looking down into the luminous ground-glass screen of a reflecting galvanometer, he adjusts a series of resistances until the needle stands at zero. This indicates that the artificial "line" forming part of the instrument itself equals in electric length the distance out to the fault. Reading from his dials, he can calculate exactly the location of the trouble, which may be anywhere from 100 yards to 100 miles away. A line crew then is dispatched to make repairs.

Curious situations often confront these linemen. They find that snakes have been thrown up into the wires, or that a wild duck has become entangled in the lines. An unusual case of "bird trouble" happened out in Kansas, where a transmission man noted a peculiar "swinging" effect every evening, just at twilight. Electrical measurements indicated that it originated near Ossawatomie, Kansas.

A man sent out to investigate found nothing unusual, but the disturbance was repeated so regularly that a lineman was stationed near this spot to watch for several days. At last he noticed that every night at sundown a huge flock of blackbirds came by and settled upon the wires. Checking with the transmission operator, he found that the weight of the birds stretched the wires and altered the electrical capacity of the circuit.

Another time, a transmission man observed a grating, irregular sound occurring at intervals during both day and night. Linemen found no evidence of trouble, so a man was stationed night and day to watch along the suspected section. In the middle of the afternoon, the transmission operator called him on the wire. "What's all the racket out there?" he demanded. "We're getting a lot of noise."

"You'll have to speak a little louder," said the lineman. "There's a train going by."

"Maybe it's the train making the trouble," suggested the transmission operator.

"Don't try to be funny," retorted the lineman. As he spoke, he happened to glance down the line, which ran close to the tracks of the Missouri Pacific Railroad. The engine was puffing out heavy clouds of thick black smoke. At a point where the telephone line was a good deal higher than the train, the smoke was pouring across the open wires. Investigation showed that the tiny particles of carbon in the smoke formed a path for current, creating a partial short circuit in the line.

OTHER frequent sources of trouble are airplanes crashing into the lines, boys' kites getting caught in them, street excavators cutting into cables, loads of hay brushing the wires down, and automobiles wrecking themselves against poles. The lead-sheathed cables are a favorite target for huntsmen, and the first rain is often followed by many cases of trouble where water has entered the cable through a bullet hole. Difficulty has been reported in some places because of the depredations of a small worm that bores its way into the cables.

Just before the rainy season, the whole system of aerial cable is gone over literally with a magnifying glass, to check against punctures in the lead sheath. This, of course, is impossible with the buried subterranean cable. Recent research, however, has developed a new type of cable filled with gas under high pressure. If a hole appears in the cable, the drop in pressure due to the escape of gas sounds a warning gong. Gage boxes along the line at intervals allow the cable men to discover what section is affected. The hole is then located by wetting the cable with a soap solution, which bubbles where the gas is escaping.

HARD WORK MADE ME A FLYER AT SIXTEEN

(Continued from page 31)

are hired. The safest flying in the world is a pleasure hop around an airport in a regular passenger-carrying plane operated by an expert pilot.

The following year, a "plane checker" was needed at the field and I got the job, working after school hours. At every large airport there is someone who takes down the numbers of all arriving planes and has the pilots sign registration slips. When a ship taxies up to the line, I hop on my bike and go out to "check it in."

THIS work was a lucky break for me. I met famous pilots from all over the country: Frank Hawks, Art Goebel, Roger Q. Williams, Clarence Chamberlin, and others. I kept my ears open and learned much from hearing such men discuss their experiences.

A job around an aviation field is a good start toward learning to fly. Anyone who is saving up for a flying course can get a free head-start by listening to pilots and mechanics talk of flying problems and watching the mistakes of beginners.

Besides checking in planes, I gave information and ran errands. On the side, I "gassed" planes, greased engine rocker arms, and did a hundred and one tasks that would give me experience. When the pilots learned they could depend on me, they gave me lots of odd jobs to do and paid me in rides. Randy Enslow used to let me take care of his dog, "Patsy," while he was flying.

It was Randy who gave me one of my most exciting rides. We "bombed a fort" at eleven o'clock at night as part of a big air show last Fourth of July. With the floodlights on, we took off in an open-cockpit Standard biplane. Randy was the pilot and I was the "gunner." I had a Very pistol that shot out a brilliant ball of fire every time I pulled the trigger.

In the middle of the field was a thirty-foot-square stockade, with two mechanics stationed inside to "defend the fort" by shooting off rockets and fireworks every time we approached. Randy would dive on the fort, I would shoot the Very pistol, and the mechanics would set off their fireworks. Sometimes we roared through a shower of sparks only fifteen feet above the fort.

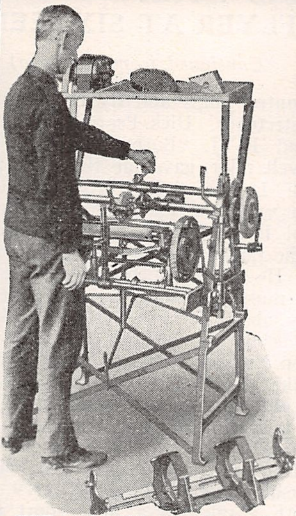
At the end of every dive, Randy would pull up in a steep climbing turn to 200 feet and dive again. That corkscrew zoom almost drove me through the seat. I had to throw overboard the empty cartridge, get a good one out of a bag under my safety belt, and load the pistol before we were over the fort again. It was dive, zoom, turn, dive, and zoom again so fast it made me dizzy.

I HAD a hard time getting the pistol loaded quickly enough, but I missed only one shot. Several of the fiery balls landed squarely in the fort and I could see them strike and roll along the ground with the mechanics hopping around to keep out of the way. Every time I fired the pistol, the mechanics would knock a board or two from the stockade so when I had used all the cartridges, the whole fort was "destroyed" and the "bombing" successful.

Another time I went up with Randy at night, we took along "Buddy" Bushmeyer, the famous parachute jumper. He floated down waving a Roman candle around his head while we spiraled about him with our landing lights on.

Some of the pilots began letting me hold the stick a little in the air and they told me what to watch in making different maneuvers in flying. Several times they let me ride in

(Continued on page 140)



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HARD WORK MADE ME A FLYER AT SIXTEEN

(Continued from page 139)

dual-control ships and fly them myself for short stretches. Dick Pears, "Chan" Chandler, and R. J. "Barney" Barbin, another Roosevelt pilot, gave me the most pointers.

Once I was flying cross-country with Barbin when he made a sharp turn in a vertical bank. When the nose dropped a little, he pulled it up quickly. I asked him why. He explained that the nose of the plane must be kept on the horizon or slightly above it in a vertical bank. If it drops below the horizon, the ship will roll over on its back. Bits of valuable information like this I jotted down. They helped me avoid trouble and saved time later on when I learned to fly.

THE nearest I ever came to being in a crash happened in June, 1929. I was up with a pilot in a little sport plane in which we sat side by side in the cockpit. He went into a fast loop at 4,000 feet. At the top, he didn't get the throttle closed quickly enough. We came out in a long vertical arc with the power on. As we leveled off, the centrifugal force drove us downward so hard three welded seat fittings let go. We crashed to the floor of the cockpit, the seat pinning the control cables so they couldn't be moved.

As soon as I could, I crawled to my knees and held the seat up off the cables while the pilot made a landing. It all happened so suddenly I didn't have time to be scared. But after I got on the ground and began thinking what might have happened, because we wore no parachutes, my hair stood on end. I resolved never to be caught in a plane stunting without a 'chute again.

The only time my flying ever interfered with my school work was in 1929 when I missed three days by flying to Washington to see Hoover inaugurated. Martin Jensen had a contract to fly pictures back to New York by plane. He said I could fly down with him in his famous Breese monoplane, the *Aloha*. That was the farthest I had ever been away from home. I stood in the rain in the street and watched the ceremonies and then went back to Hoover Field and found all the planes mired down in the mud, unable to take off. It was three days before the weather cleared and I could fly home. My grandmother lives in Washington and I stayed with her, so the whole trip cost me only $1.50.

But even that seemed quite a bit because I was piling up every nickel I could get for the "flying fund." By the spring of 1930, when I was sixteen, I had enough to start in the school at Roosevelt Field. I took my instruction at seven o'clock in the evening so I could continue my regular work at the field. As I already knew how to keep a straight course and make turns, "Husky" Fluellen, my 190-pound instructor, who weighed almost twice as much as I did, let me practice landings the first day. Ordinarily it is a week or so before a student begins this part of his training.

THREE and a half hours after I began instruction, I made a solo flight. The lessons I learned while flying as passenger cut my instruction time in half. My greatest difficulty was learning to steer a straight course on the take-off. I had been used to handling the rudder in the air where the slightest pressure brings results. On the ground, the slower-moving ship had to be given almost full rudder to turn it.

After I had groundlooped, or run around in circles on the ground, half a dozen times, I got the knack of keeping the ship taxiing straight and the

(Continued on page 141)

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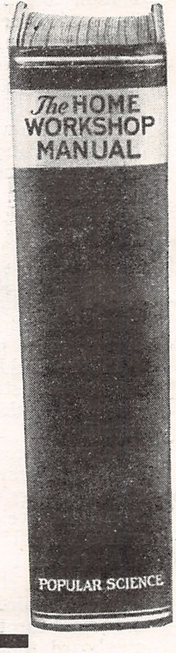

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HARD WORK MADE ME A FLYER AT SIXTEEN

(Continued from page 140)

rest was comparatively easy. At the end of ten hours solo, I passed the tests and won a private pilot's license.

Roosevelt Field is the eastern distributor for a light plane, a tiny, thirty-horsepower machine, nicknamed by pilots "The Baby's Bathtub." I asked permission to use one in an attempt to set a light plane altitude record and consent was given. To make the record official, I took out an F. A. I. license, the certificate required by the international governing body of aviation. I also hold a sporting license. This makes three I have been awarded.

A FIFTEEN-MILE wind was blowing out of the north when I took off for the long climb. The little tanks of the plane were crammed with eight gallons of fuel. I used five on the flight. The start was made at 3:30 P.M. on a perfect late summer day. Above 3,000 feet, the air was smooth as glass. Compared to the roar of a Whirlwind or Wasp motor, the sound of the little engine was the hum of a bumblebee. I circled over the north shore, above Oyster Bay, so if the wind freshened I would not be carried out to sea.

As I climbed, the houses and fields shrank in size. The huge concrete hangars at the field, each holding half a dozen planes, looked no bigger than the heads of pencils. I could see the tiny skyscrapers of New York to the west; the brown Connecticut hills across the sound to the north; Peconic Bay and the two forks at the tip of Long Island to the east, and, far out on the Atlantic, to the south, two steamers the size of ants, heading for Europe.

At the end of an hour and a half I reached the peak of my climb. The temperature had fallen to nine degrees above zero. But I wore a fleece-lined suit and didn't notice the cold. The altimeter pointed to more than 11,000 feet, but I had no difficulty in breathing. The only thing that bothered me was the fact that the plane would "mush down" through the thin air, or settle, every time I pulled the stick back and tried to climb. The unprotected carburetor was affected by the cold and the engine had lost much of its power.

For fifteen minutes, I tried unsuccessfully to gain a few additional feet. Then I closed the throttle and started the glide back to earth. Every few minutes during the descent I would "gun the motor," clearing it out with a brief burst of speed so it would not clog up and stop on the way down.

THE descent took half an hour and lights were springing up all over Long Island in the dusk when I sat down and taxied up to the starting line. After the Bureau of Standards had calibrated the barograph I carried, I was awarded the official American record for planes of this weight at 10,525 feet. The highest I had ever been before was about six thousand feet as passenger.

I am still checking in ships at the field and learning things every day. Whenever I can save up enough to hire a plane, or when one of the private owners at the field will lend me one, I pile up flying hours toward a higher license. By the time I am eighteen, I hope to have most of the 200 hours necessary for a transport license. So far, I have flown eight different types of planes, the largest a Waco biplane with a 165-horsepower Wright engine. Some day, I hope to have a chance to handle a "big boy," as pilots call a multi-motored ship. My plan is to put on some more weight, get a transport license, and then pilot the big boys!

"LOOK-Miss Nobody thinks she can play" someone whispered

—but when she sat down at the piano . . .

Eileen had never expected to be asked to Grace Williams' party. Grace Williams—the leader of the most exclusive set in town.

Eileen was thrilled—yet so frightened. Well, she had already accepted Bill Gordon's invitation, and now she'd have to go through with it.

That night Bill called for her. "You look adorable," he told her. Eileen wondered how the others would feel about her. She soon found out.

It was while they were playing bridge. "Who is that girl with Bill?" she heard someone whisper.

"I never saw her before. Nobody of importance, I guess," came the reply.

Eileen blushed. So! Soon the bridge tables were pushed away.

"Where's Jim Blake tonight? If he were here we could have some music."

"Jim had to go out of town on business," came the answer. Here was Eileen's chance. "I can play a little," she said timidly.

There was a moment of silence. Hesitantly Eileen played a few chords—then broke into the strains of "Nola." Her listeners sat spellbound. Never had she played with such confidence. It was almost an hour before she rose from the piano . . . later Eileen told Bill a surprising story.

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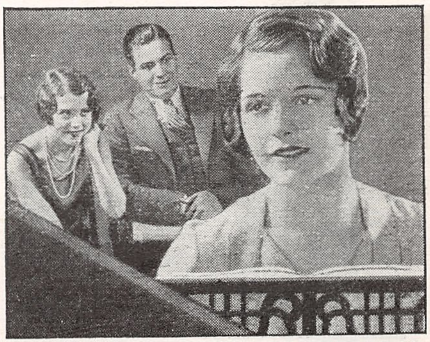

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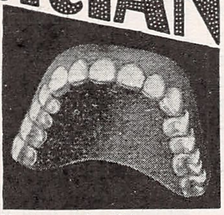

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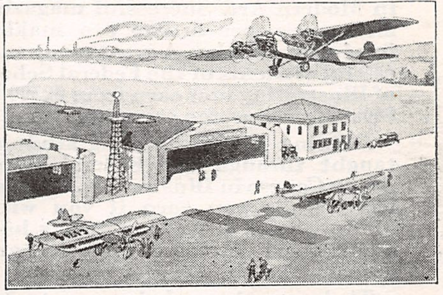
A definite program for getting ahead financially will be found on page four of this issue.



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RICHES IN MYSTERIOUS OCEAN SHELLS

(Continued from page 57)

develop to their greatest size, the motorboat is anchored about 200 yards from the breakers that pound the rocky points, and the divers, in pairs, step into the long boats, which, rowed to within fifty feet of the tumbling white water, are anchored with bow and stern hooks. Both divers don their suits, though only one goes down at a time, the other remaining ready to go instantly to the aid of the other in case of accident.

IN HIS preparations, the diver first steps into combined trousers and shirt, made of rubber and weighing eighty pounds. Then he puts on lead-soled shoes weighing twenty pounds each and buckles on a belt carrying fifteen ten-pound blocks of lead, hooked to the belt like cartridge clips on a bandolier, so that they may be dropped off easily in case the diver wishes to get quickly to the surface. Finally, the diver's assistant covers the undersea fisherman's head with a seventy-pound helmet, all metal except for a thick glass frontpiece.

Thus, in addition to his own 150 pounds or more, the diver carries 340 pounds of additional weight, yet frequently even this is not enough to keep him from being battered against boulders and ledges when the currents run heavily on the bottom of the Pacific. After the diver is dressed, the air hose is tested, and the rope running with it hooked into the shoulder plate of the diving suit, so that no strain may come on the rubber tube at the point where it enters the helmet. Sometimes the air pump is operated by a small gasoline engine and sometimes by hand.

A heavy iron ladder leads down into the rough water from a two-inch pipe, clamped across the gunwales, well forward. Onto this the diver steps, walking slowly down until only his head, arms, and shoulders remain above the surface. An attendant hands him a basket made of heavy netting woven to an iron ring about eighteen inches in diameter and a flat steel bar two to three feet long, with a chisel tip at one end and a sharp point at the other. This bar, an inch to an inch and a half wide by a quarter of an inch thick, is the diver's fishing rod, pick, crowbar, and weapon, all in one. It is looped to his wrist by a leather thong, while the basket carries a light, strong line, the end of which is held by one of the men remaining in the boat. Hung from his belt, at the middle of his back, the diver carries in a brass scabbard a heavy, two-edged knife, with blade fourteen inches long. This is also a weapon and a tool for cutting away the kelp trunks and branches in which he may become entangled.

WHEN all is ready, a man stations himself at the air pump, where he maintains constant pressure of sixty pounds through a reserve tank so that, even if the pump breaks down, there still will be enough air available to maintain the diver's life until he can be hauled to the surface. Another man takes the life line, by which the diver communicates with the men in the boat; a third cares for the basket line; and a fourth, armed with a fifteen to twenty foot pole, headed with a two-foot, razor-sharp, steel blade, stands by to cut kelp.

As the diver disappears, a line of bubbles, dimly discernible in the foam of the swirling sea, marks his course. Abalones usually are found in colonies. If the diver does not get the flat end of his bar under the shell before the mollusk clamps down on the rock or kelp root, he leaves it. Shells of the abalones must not be *(Continued on page 143)*

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RICHES IN MYSTERIOUS OCEAN SHELLS

(Continued from page 142)

broken, and the only way one of these univales can be removed after it has gripped the rock is by smashing it.

When the diver gets the end of his bar under the abalone, he gives it a quick lift and a dexterous turn, throwing it over on its shell so that it has nothing to grip with its powerful foot. Then the diver drops the catch into the basket. When this receptacle is filled, usually with some two dozen abalones, he signals for a haul-away and a new basket.

As THE abalones reach the boat, one is placed shell down on a flat board. Then the open side of another is laid on the open side of this first shell. Both clamp together immediately. A third is then laid with its open side on top of the shell of the second, a fourth on top of the third, and so on until a solid column is built up as high as the fisherman can reach. The abalones, of course, immediately grip the shell beneath, and the column becomes solid. Then these "poles of abalones," are laid, like logs, in the bottom of the boat, where they remain, clinging solidly to each other until they are separated at the packing plant on shore.

Meantime, the man with the long lance has cut away hundreds of pounds of kelp leaves and branches as they swayed and swirled around the boat. This gives more light to the diver, enables his companions to see the bubbles and follow his course, and gets rid of the entangling and deadly upper branches of the seaweed. Stalks of this kelp frequently are more than 100 feet long, six inches to a foot in diameter at the bottom, and as tough as rawhide.

Down below, the diver has his own problems. He must first pass through the forests of kelp whose trunks are grown firmly to the rocks, often only a foot or two apart and covering hundreds of acres. Tough as leather, resilient as rubber, and moved constantly by the currents, these long, smooth trunks seem to seize and hold everything that comes within their reach. If the diver becomes entangled, as he not infrequently does, he must cut himself free, without damaging or fouling his air line and without making inadvertent signals for unwanted assistance on his lifeline.

When the diver has finished his working day of five hours, the boats are towed back to the packing plant. There the abalone meat is removed, divided into "light" and "dark," the shells thoroughly cleaned, the pearls preserved, and the flesh either packed for shipment to the fresh-fish markets or canned. After the large shells are dried, they are sent to the manufacturing jewelers and novelty makers, where they are converted into 273 different articles, including costume or "period" jewelry.

THERE is still much mystery about the abalone. Though it is a single-shelled slow-moving mollusk, not usually considered a migrant, it will fill, in one night, a location which, the day before, contained no abalones. Where it comes from is not definitely known, but it is believed that farther out, on great ledges, possibly at depths of 300 to 1,000 feet or more, there are vast colonies of this valuable shellfish, from which the younger members are crowded out so that they move inshore. Whatever may be the source, the rocks which the divers are able to reach are being refilled constantly with abalones. Few of these exceed twelve inches in diameter, while many are below the eight-inch limit; but every now and then a monster nearly a foot and a half across appears suddenly out of the deep.

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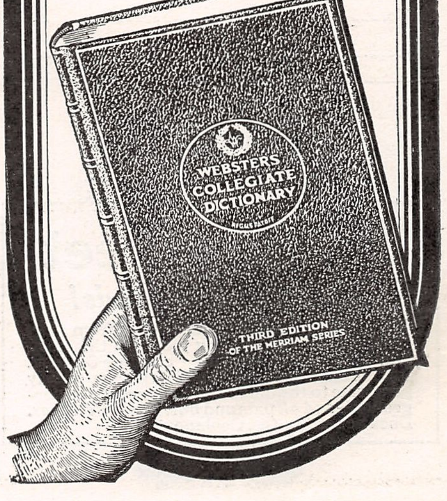

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WHY CAN'T MEN BECOME GIANTS?

(*Continued from page 61*)

and stronger material for making the bones, or he must admit a diminution of strength in comparison with men of medium stature; for if his height be increased inordinately he will fall and be crushed under his own weight."

The same principle applies to those inanimate giants like the Chrysler Building, which rear their heads 1,000 feet and more into the sky. If a structure of such height could be built of stone, the thickness of the walls needed to support the tower's weight would be so great as to defeat the purpose of a high building—namely, to provide maximum office space on a given ground area. However, steel in structural shapes supplies a material for the building's "bones" which makes them strong enough to carry the load without consuming too much floor space, thus making a 1,000-foot tower possible—and profitable.

BEING the largest of quadrupeds carries a penalty with it, for the elephant's mass, or weight, increasing as the cube of his height, requires such a correspondingly exaggerated development of his leg bones that his movements tend to be slow and clumsy. Certain activities, such as leaping fences, are taboo to the elephant.

Almost every one has noticed the more graceful proportion of young trees as compared with old ones. The reason becomes obvious when we apply Galileo's rule. Here the weight of the trunk, increasing as the cube of its height, requires that the trunk thickness vary as the square root of the cube of the height. Large trees, like large animals, therefore require larger underpinning.

It is plain from all that we have now found out that the force of gravity upon the earth sets a definite limit to the size of animals, including man. The giraffe, the ostrich, and the stork are striking examples of how Nature conforms to this rule by making tall animals of light construction. What would be the effect of Jupiter's force of gravitation upon its supposed human inhabitants?

Since the mass exerting gravitational attraction increases with the cube of the diameter, Jupiter, with its 86,500-mile diameter, will exercise about 1,400 times the pull that the earth does with a mass proportional to its 8,000-mile thickness. Neglecting the effect of increased atmospheric density, a man on Jupiter would consequently weigh many times more, and his stature would be proportionately limited, or else Nature would shape him as a veritable stork or spider built to a small scale.

IN view of what has been said, it seems at first that the force of gravity is inoperative in limiting the size of whales, which are the largest living things upon earth. But we have only to remember that the whale's body displaces an enormous volume of water, and that this displaced water, being unable to fill the space occupied by the whale, presses upon and supports his body with a force equal to its own weight. The surprising conclusion follows that the whale's body, while immersed in the sea, can be said to weigh nothing! The law curtailing the growth of elephant and man is suspended for the whale's benefit, leaving him free from the limitation of size imposed upon animals who walk upon land.

The immunity from harm of a mouse falling down a mine shaft, and the fatal effects of such a tumble upon a man, both depend upon another application of our same rule—the surface varies as the square of the length, while the weight varies as its cube. Therefore the weight of the mouse is many times less, *in comparison to the surface of its body,* than a man's weight is to his body's surface.

A man in falling is accordingly held back very little by the resistance of the air, but the mouse, with a relatively enormous surface in proportion to its tiny weight, is held back so much that it is let down the shaft upon the equivalent of an "air-cushion," and reaches the bottom with a comparatively slight impact. Here too is the explanation of why tiny dust particles may float in the air for hours.

A SLIGHTLY different application of our infallible rule explains the small velocity needed, relative to the surrounding air, to keep a humming bird poised almost stationary. Here again, the tiny mass of the humming bird's body makes the impulses given to the air by the *surfaces* of its wings many times more effective than they would be were it the size of an eagle. The wing surfaces of the eagle, having a much greater proportionate weight to lift, must at first be aided by a short run along the ground, in order to attain a minimum flying speed. This is why a large bird can be effectively "caged" in a small inclosure entirely open to the sky.

The explanation of man's inability to fly at all with wings propelled by his own muscular powers can be made plain by a few moments' comparison of the wing area needed to lift a human body with the mass of a man's breast and back muscles. These are comparatively small and weak when compared, size for size, with those of a bird like a sea gull. But in the last analysis, man's early dreams of flying with flapping wings were doomed by "the cube of his length," and the increase in muscle and bone strength needed for flight would still further increase the mass to be lifted. It is in fact doubtful whether a bird the size of a man could fly at all.

Man's weak leaping powers, as compared with those of a grasshopper, are already clear from his inability to fly. In his jumping ability he is earth-bound because of his large weight compared with his available muscular strength, irrespective of the specialized leg-structure which gives the grasshopper additional advantages.

GERMAN AIRSHIPS USE AMERICAN HELIUM

GERMANY'S latest super-Zeppelins, now under construction, will be floated with American helium gas. Dr. Hugo Eckener, commander of the *Graf Zeppelin,* recently announced that satisfactory negotiations had been concluded for the export of this gas to Germany. It will be the first foreign shipment of its size. Hitherto U. S. Government authorities have guarded closely America's supply of helium, of which we have a virtual monopoly. However, recent discoveries of new fields and methods of quantity production assure the United States of more than enough for its own airships.

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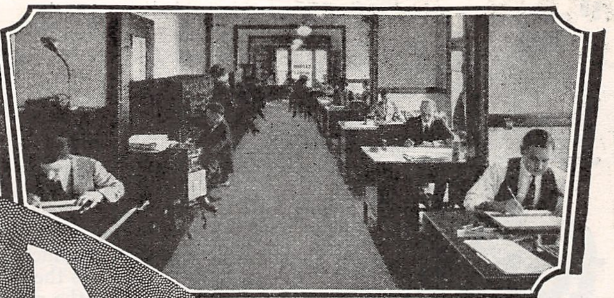

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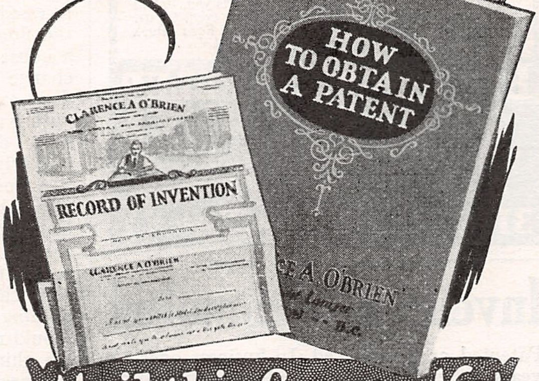

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DON'T LET RULES MAR YOUR HOUSE

(Continued from page 77)

Within the entrance, at the left is a closed stairway to the second floor—closed for economy of space. The entrance hall is small but adequate, with coat closets at the right. Directly in front, as one enters, is the living room, which, as I think should always be the case, is the heart of the whole house.

At the right, as one enters, is the entrance to the porch. At the left is a large fireplace with built-in bookcases of unequal size in the wall space flanking it. The south side of the house has many windows, and this effect is accented in the living room by a large bay thrust out to the south. From the open porch there is a short step down to the terrace in the lawn along the south side of the house.

ALL wall papers and furnishings on the first floor are early American in character. Incidentally, most of the furnishings are at least 150 years old, in my wife's family or my own for several generations.

The woodwork throughout the house is finished in enamel, but not in the usual chilly white or light tints. It is done in a warm shade, very nearly what one might call buff. Floors are of oak.

The closed stairway and the second floor hall have plenty of natural light from a north window—the only window on that side of the house. There are three bedrooms on the second floor, the main one being in the east end, having windows both east and south. Ceilings here are seven feet, four inches, which is six inches lower than those of the first floor. Low ceilings give a feeling of intimacy and snugness.

The bath is in the northeast corner of the second floor, thus concentrating the plumbing with that of the kitchen in that portion of the structure. The bath is simple and small, having lavatory, water closet, and recessed tub with combination shower. While the floor is of tile, the walls are not, as in a house of this type it is better to be able to change the color scheme of the walls at will. This can be done easily from time to time with waterproof paint. With tile it is much more difficult to do this. A good paint, properly applied, is nearly as practical as tile.

A hot water system of heating with complete thermostatic control is located in the basement, and this system also heats the garage. There is also a well-equipped laundry in the basement.

A chimney, essential in this climate, is nothing of which to be ashamed, and it should not be taken lightly. Properly treated the chimney may add much to the house's appearance and air of completeness. From the standpoint of economy and practicability, we built one main chimney approximately in the center of the house, possessing three flues that serve the fireplace, the gas range in the kitchen, and the heating plant.

CONTRARY to the general practice of making the chimney as short as possible, this one, of common brick, extends fully six feet above the ridge of the roof. It is appropriate to the pre-Georgian precedents followed in designing this house.

The roof is of plain, unstained, cedar shingles, as I have great faith in the value of such roofing. With the possible exception of slate, many colored and artificial roofing materials fade or discolor and are not altogether satisfactory.

Considerable planting has been done about this home. There is a lusty young elm in the lawn near the street while shrubbery, chiefly of a low-growing variety, softens the severe lines of the house.

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TRADE-MARKS

A definite program for getting ahead financially will be found on page four of this issue.

CHAIN BROADCASTS ON ONE WAVE

(Continued from page 82)

a vacuum tube, will produce electrical oscillations at one undeviating rate so long as its temperature remains constant and there is no mechanical change in the mounting. The variation with temperature changes is relatively slight, and was not considered when quartz crystals first came into use to control broadcast frequencies. The latest practice is to inclose the entire quartz control unit in a heavily padded box which is maintained at constant temperature by an electric heating element controlled by a thermostat.

The quartz crystal oscillator forms the basis on which several different systems for synchronous broadcasting have been worked out. On page eighty-two our artist has drawn a synchronous broadcasting set-up for two stations. Two quartz crystals are carefully matched to oscillate at precisely the same frequency.

One of this matched pair is connected in at one station and then forms the master control. The other crystal is applied to control the frequency of the other station. In the hook-up of this second crystal there is provided an adjustment capable of shifting the oscillation of the crystal a few cycles either way. This is necessary because even a crystal oscillator will change slightly.

AT SOME convenient point about midway between the two broadcasting stations there is placed an ordinary receiving outfit which is permanently tuned to the wave on which the stations are to operate. This monitoring station is connected by wire line to the station at which is located the controllable crystal. The operator detailed to monitor service listens to the reception at the mid-point between the two stations and adjusts the crystal control at his station so that it is at all times in step with the master crystal.

Another scheme that is undergoing tests is to send out from the master control station a short carrier wave modulated by the frequency at which it is desired to operate the group of stations. At each station in the chain the frequency of oscillation is controlled by the oscillation sent to it from the master station by way of the short wave.

Still another method is to transmit by way of the wire lines a low frequency oscillation and then make the various transmitters oscillate at some designated multiple or harmonic of this frequency.

It is easy to see why thousands of listeners will benefit by synchronous broadcasting. Assume, for example, that a man lives so far from one transmitter that he cannot get satisfactory reception. In many such cases the nearest station in another direction that is transmitting the same program on a different wave also cannot be heard with sufficient volume. When these two stations are synchronized on the same wave the man will get the combined effect of both stations, and this will give him adequate volume.

SYNCHRONOUS broadcasting by two stations already has been successfully accomplished. The Federal Radio Commission has sanctioned more elaborate tests.

It now remains to be seen whether unforeseen technical difficulties will prevent synchronizing more than two or three stations. If none arise we may confidently expect in the near future as many as seventy-five stations all broadcasting the same program at the same time on the same wave length. This will leave room for seventy-four new stations to furnish us as many different programs from which to choose during the chain broadcasting hours!

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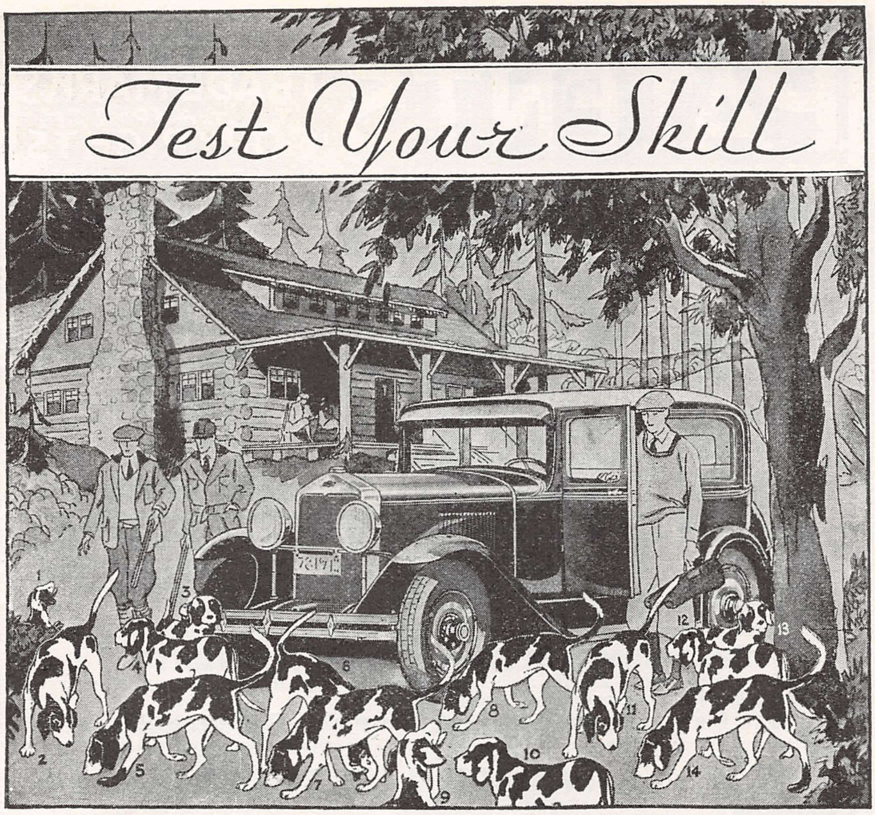

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HOW I BREED LIONS

(Continued from page 59)

ills. But the whiskers are worth more where they are and besides, who's going to pull them out?

Depending upon size, sex, condition, and other points, a three-year-old, well developed lion is worth from $1,000 up. Diet, surroundings, and such other conditions as contribute to the health and appearance of the big cats are carefully watched.

Should one of the husky youngsters develop unusual meanness or become too much of a bully, he "gets a tag," and is sent to "solitary" until he is willing to be good. When rough or quarrelsome, lions accumulate scars and occasionally become cripples, and a scarred or crippled beast represents an actual loss in value.

IT HAS been learned that lions are not seasonal in their breeding habits, and though certain pairs are more companionable and show marked affection for each other, the female will mate with any lion. The litters are from one to four, with males predominating. Most females have two litters per year. Rosie, the first mother lioness I had, produced forty cubs up to her death three years ago.

The lioness is a notoriously poor mother, in many cases being neglectful to the point of walking off and leaving her young. We have found that this is quite likely to happen when there is only one cub.

New-born cubs are spotted all over and retain their spots until they are about two months old. This it is said is Nature's means of protecting them from their natural enemies, the spots providing an effective camouflage until the cubs are old enough to scamper out of danger's way.

Not long ago a curious phenomenon took place at our farm when a litter of four snow white cubs arrived, the only ones of their kind so far as I know. Two had blue eyes, the other pair being pure albinos with pink eyes. But they didn't live long. Had they survived, they would have been worth a fortune. If even one had reached maturity it would have been difficult to estimate his value.

A lion grows until he is seven years old and is not used for breeding until maturity. The lioness is bred at six years, which explains why only 150 lions have been raised over a period of ten years. Sickness and deaths have occurred, but the mortality percentage is small.

APPENDICITIS, pneumonia, and cirrhosis of the liver are the diseases to which our lions are most susceptible. The administering of the medicines, in some instances, is a difficult undertaking. Sometimes not enough, or too much, is given. In the case of Rosie, it was an overdose of medicine that caused her death.

A fact that few people know is that lions of the veldt and the jungle are never as handsome as those raised in captivity. Especially is this true of the males. The wild lion gets thorns and burrs in his mane as fast as it grows and in removing these with his claws much of the hair is pulled out. It is therefore the captive lion that exhibits the finest mane.

At our farm, the animals act as naturally as though they were at home on a sun-dried veldt of South Africa.

In its wild state, the lion is difficult to observe. Danger is involved in prying into its intimate affairs on its native stamping ground. But, at our lion farm, they can be safely studied close at hand. With nearly 200 animals under observation, interesting new facts are being added to the store of information about this King of Beasts.

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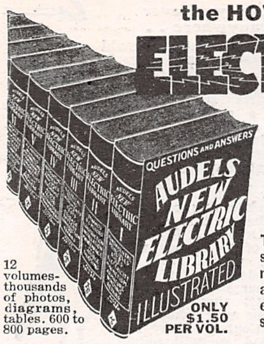
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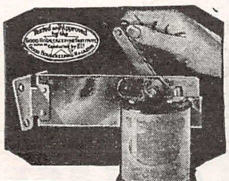

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A definite program for getting ahead financially will be found on page four of this issue.

GUS GIVES POINTERS ON CAR BUYING

(Continued from page 86)

"The same thing applies to batteries. They're like tires—only good for so long anyhow. A battery that'll start the second-hand car in fine style when you get a demonstration may go all to pieces in six months. Sometimes a new car battery does that too, but not if you take care of it."

"Why couldn't you take care of the second-hand car battery the same way and get the same results?" Bill broke in.

"Because," Gus explained, "taking care of a battery isn't going to put back the material that's fallen off the plates or patch up the holes in the separators that are going to cause short circuits. Babying along a bum battery after it starts to go bad is a waste of time.

"THAT'S two items," Gus continued, "and there's a lot more. You can't tell how much carbon there is in the cylinders or even how many miles it'll be before the valves will need regrinding just by lifting the hood and looking at the motor. How long will it be before the starter motor itself is going to need attention? Or the generator? Or the clutch? Or the brakes need relining? You can't tell from the outside. That's where the gamble comes in. Maybe not one of these parts'll give you a bit of trouble for years. Then again they may all go on the blink the first month and that's just your hard luck.

"There's another thing," he went on. "When you buy a secondhand car, it's already out of date. Suppose it's three years old when you get it. Look around and see how the cars that are five years old look to you today. Kind of ancient, don't they? Your three-year-old car is going to look just as ancient to you and everybody else in only two years.

"Don't get the idea that a secondhand car is always a lemon," Gus cautioned. "It may be a much better buy than a new car. When a man buys a new car he pays the factory price plus the freight charge and also a 'service' charge, so what he pays is a lot more than the advertised price. Then if he drives it for a couple of months and tries to sell it, he has to take a big loss even if the car looks just like new and is in mechanically perfect condition. It may be even better than new if he's broken it in real careful. If he keeps it over a year and then tries to sell it, he has to take two years' depreciation instead of one.

"MAYBE he has kept it in fine shape and only driven it three or four thousand miles. Figured on a dollars per mile basis, the fellow that buys that car is getting a real bargain. It's only a tenth worn out any way you figure it, and he gets it for half or maybe a third of what it cost."

"Sure sounds like a bargain the way you put it," said Bill. "But why does the fellow that bought the car in the first place sell it so cheap?"

"That's just human nature again," Gus maintained. "He's like the woman who throws away a perfectly good pair of shoes or a dress and buys a new dress or shoes just because the ones she had weren't exactly like what every other woman happened to be wearing that particular month. Keeping up with the styles is fine, son, if you can afford it."

"Then," said Bill, "you think I'd be taking less chance on buying a new car but I might get a much better bargain in a second-hand one?"

"That's about the way it sizes up," Gus grinned. "Like a lot of other propositions it all depends on how you look at it!"

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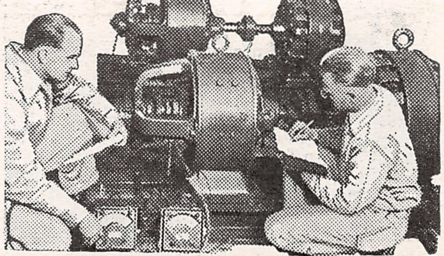

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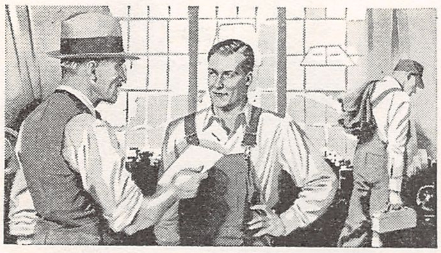

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MIGHTY LANDSLIDES REMAKE THE EARTH

(Continued from page 41)

rains, earthquake tremors, and extensive mining operations all contributed to this disaster.

The most stupendous of all known landslide disasters occurred as recently as the year 1920 in the province of Kansu, China, when a great earthquake precipitated colossal masses of the soft "loess" soil into the valleys. A vast area was affected, and though the region is not densely populated it was estimated that fully 100,000 lives were lost.

On February 18, 1911, at Sarez, in the Pamirs of Central Asia, a mass of rock containing 3,270,000,000 cubic yards and weighing 7,000,000,000 tons fell suddenly through a height of 900 to 1,800 feet. The resulting shock was registered by a seismograph at Pulkova, nearly 2,000 miles away, yet the energy of this mighty landslide was calculated to be only about one thousandth that of the earthquake that occurred in California in 1906.

The same force of gravity that causes landslides is responsible for a slow downward movement of surface material on the sides of hills and mountains.

THIS movement is usually too slow to be seen, but it results in a gradual accumulation of material at the base of slopes.

The creeping of a mountainside generally does not extend to a great depth, but in the case of Monte Arbino, the celebrated "moving mountain" in the Swiss canton of Ticino, the whole mountain is gradually settling and spreading laterally. These movements have been carefully measured for many years by Swiss government engineers, who have established numerous observation points on the mountain for this purpose.

During the first quarter of the present century the lateral movements of this mountain averaged two to six inches a year. In 1925 the rate increased to ten inches and in 1926 to eighteen inches. In 1927 the mountain side slipped about five feet, and during the first nine months of 1928 it advanced forty-six feet. On the first of October the rate of movement had become six inches an hour.

Long before this date the prospects of a general collapse led the authorities to order an evacuation of the danger zone. Hence there was no loss of life when, on October 2, 1928, upwards of 30,000,000 cubic yards of earth and rocks fell in a succession of gigantic cascades into the adjacent valleys, burying forests, fields, houses, and roads, and, by damming a stream, formed a lake that may eventually be a source of disastrous floods in the surrounding country.

A correspondent of the London *Times* who visited the scene of this remarkable slide on October 8, when much material was still falling, wrote:

"THE top of the moving mountain has subsided by at least 150 feet and the whole region looks like a battlefield. Small rocks continually crash down into the valley, and their rattling is like the noise of quick-firing guns, while the clouds of dust rising from the places where the falling rocks strike and burst into pieces remind one of the bursting of hundreds of shells. From time to time a bigger boulder on the opposite ridge begins to oscillate and then to roll, makes amazing leaps down the slope, causes the unsteady ground to shake, and finally crashes at the bottom with a noise like thunder."

Monte Arbino is still moving, but the movements are now confined to the upper slopes and further downfalls comparable in magnitude to the one of 1928 are not looked for by the Swiss geologists.

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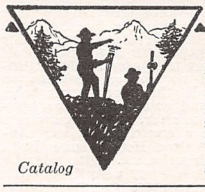

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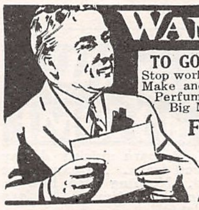

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ROBOT ELEVATORS TO SERVE 85,000

(Continued from page 45)

level and stop the car. The doors, which are opened and closed by an electric motor, are actuated simultaneously.

Not only was it necessary to provide electrical and mechanical devices to attend to the normal operation of the elevators, but devices to attend also to their safety. So much attention has been given to the question of safety that the chances of meeting with an accident in an elevator in this new installation are four or five times smaller than the chances of an accident in your automobile.

"WHAT if a cable should break?" someone asks. The answer may be surprising. The safety of the car would not be interfered with. The cables are frequently inspected, and there are six cables to support each car, though the cars in the two highest banks of the Empire State Building have *eight* cables. Should flaws pass undetected, and one, two, three, four, or even five cables break, the car would not drop, as one cable is sufficient to carry the whole load! Of course an attendant will not continue to run a car with even one cable broken. The passengers would be left off at the nearest landing, and the elevator would not be put into service again until the cable had been replaced.

The present law in New York City limits the speed of elevators to 700 feet a minute. Certain that this law will soon be changed, eighteen of the Empire State elevators are arranged for a future speed of 800 feet a minute, eighteen for 1,000 feet, and eighteen more for 1,200 feet. The latter are the fastest passenger elevators ever made.

According to Otis engineers, the speed limit with modern equipment is not determined by factors of safety but by the normal distance between stops. In a department store, where stops must be made at every floor, 500 feet a minute would be more sensible than 1,200; but where a clear jump of nearly 800 feet must be made the lower speed is ridiculous.

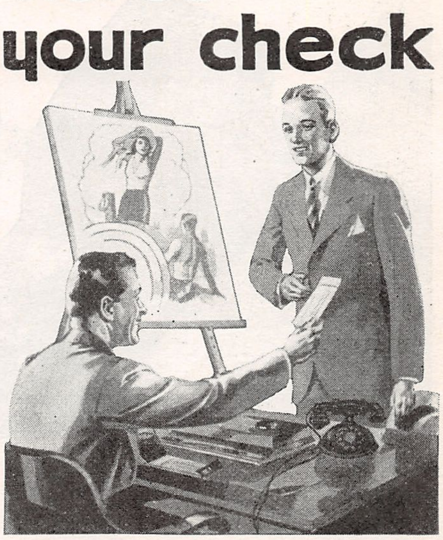
That the traffic may be handled with the greatest expediency, an indicating panel and a dispatching panel are adjacent to each bank of cars. On one, lights show at a glance the position of every elevator in the bank; two columns of lights of a different color indicate the floors at which buttons have been pushed by waiting passengers. On the other panel are telephone, switches, and the control of an automatic dispatching device.

Ordinarily this device signals the attendant of a car when his car is the next to leave, then gives him another signal at the precise moment he should initiate the closing of the doors. Its operation may be speeded or retarded to suit the traffic, at the will of the dispatcher, or the dispatcher may start or recall cars independent of the device, by manipulating the switches.

EACH elevator has a telephone, interconnected through an automatic 200-station switchboard with each other, with the starter, the engineer, the superintendent, and with a station on each floor.

The highest rise of any of the cars is made by Freight Elevator No. 1, which travels from the sub-basement to the eightieth floor, 986 feet. None of the cars that ascend from the lobby go higher. Two local cars provide service between the seventy-ninth and the eighty-sixth floors. It is planned to have another elevator in the mooring mast, rising to an observation platform 1,210 feet above the ground.

"Here's your check



your drawing's OK"

SOME men make more money playing than others do working. They have been far-sighted enough to turn a hobby into a real source of money. Perhaps you've always liked to take a pencil and draw little figures. Successful artists are simply men who have kept on drawing little figures, studying and practicing, until they became expert. You may have just as much ability. It costs you nothing to find out—and it may be the most valuable discovery of your life.

The Federal Schools have taught hundreds of successful students. Many are now earning from $2,500 to $6,000 a year—others even more. Many famous artists contributed to this simple, thorough home course. In spare time you can learn the things they know about commercial art, lettering, poster designing, color harmony, fashion drawing, etc. Send coupon below—get the free book, "Your Future," which tells what other Federal students have done. With it, you will receive our Free Vocational Art Test, which our artists will use to judge your ability. You may have real talent. Don't let it rust—it can bring you bigger money and an easier, happier life. Write today.

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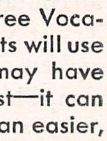

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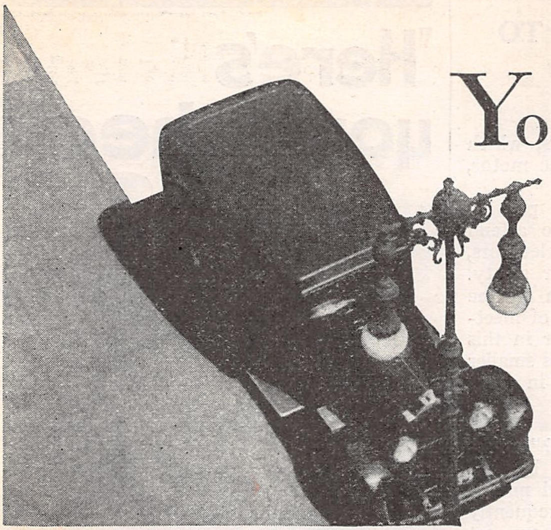
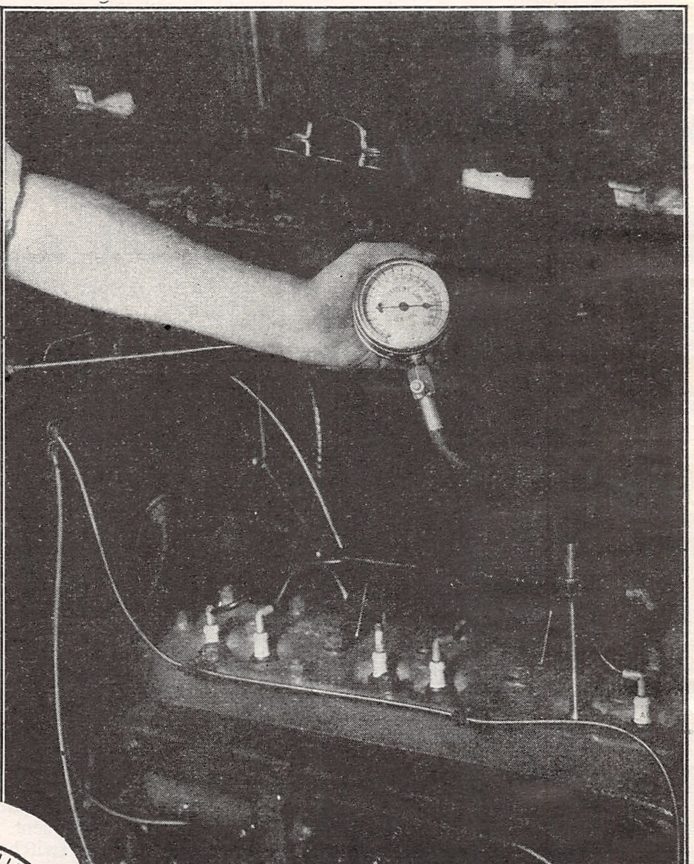


You call it an *Automobile*

BUT—

we call it *apparatus* in Ethyl laboratories



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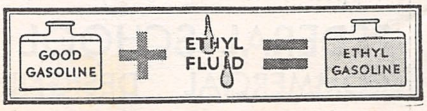

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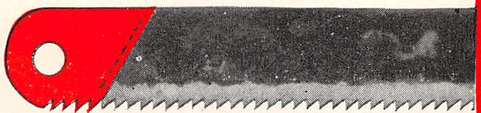

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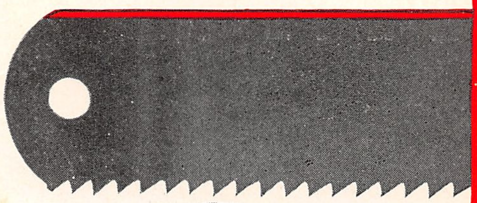

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